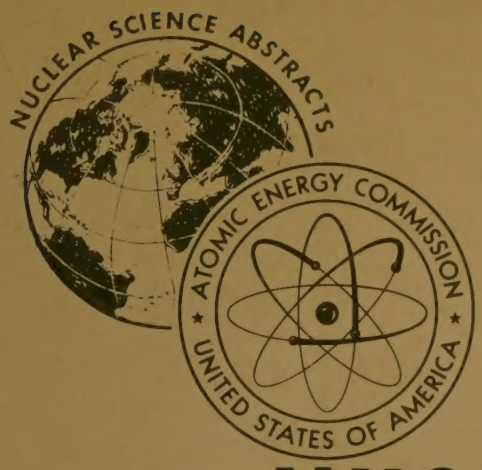

NUCLEAR SCIENCE ABSTRACTS

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April 15, 1961

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NUCLEAR SCIENCE ABSTRACTS

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GENERAL AND MISCELLANEOUS

7124 (ARL-TR-60-290) SUMMARY REPORT FOR THE DESIGN OF AN ION ROCKET RESEARCH DEVICE. C. R. Dulgeroff and D. J. Kerrisk (Rocketdyne Div., North American Aviation, Inc., Canoga Park, Calif.). Oct. 1960. 52p. Project No. 7116. Contract AF33(616)-5927.

A bell-jar vacuum system and a vacuum chamber used for research on high current density ion sources are described. Porous samples of nickel, graphite, tungsten, tantalum, and titanium carbide were tested for ability to produce cesium ions by surface ionization. Nickel and graphite were inadequate because of reactions with cesium vapor. Tungsten, tantalum, and titanium carbide produced positive ions. Tungsten produced current densities up to 12 ma/cm^2 and has an ionization efficiency greater than 90%. Secondary-electron-emission studies were made to ensure true current measurements. An analytical study of arc type ion sources was made to determine types best suited for high-current-density ion beams. (auth)

7125 (CEA-1379) UN LABORATOIRE CHAUD MOBILE. (A Mobile Hot Laboratory). S. Trouve, M. Rapin, and E. Mestre (France. Commissariat à l'Énergie Atomique. Centre d'Études Nucléaires, Saclay). 1960. 23p.

An autonomous hot laboratory that can be constructed in a short time is described. Some examples of equipment and uses are given. (auth)

7126 (JPLAI/Survey/1D) ASTRONAUTICS INFORMATION. OPEN LITERATURE SURVEY. VOLUME 1, PART D (Entries 13,166-13,888). (California Inst. of Tech. Pasadena. Jet Propulsion Lab.). Jan. 15, 1960. 115p. Contract NASw-6.

An open literature survey dealing with astronautics is presented. The period covered by the survey is October 15 to December 15, 1959. A list of periodical references is presented alphabetically. Author and subject indexes are included. 700 references. (J.R.D.)

7127 (NP-9737) PRELIMINARY REPORT ON THE WESTINGHOUSE 5 K.W. THERMOELECTRIC GENERATOR. J. C. Kastovich, M. D. Fisher, and W. C. Moreland (Westinghouse Electric Corp. New Products Labs., Cheswick, Penna). Aug. 1960. 30p. Contract NObs-77093.

The design, fabrication, and testing of a high power, fossil-fuel fired thermoelectric generator is discussed. The history of development of the component systems is summarized. Results of both full scale generator testing and individual module testing are presented in the Appendix. (auth)

7128 (TID-11516) SEISMIC GROUND EFFECTS FROM COUPLED AND DECOUPLED SHOTS IN SALT. Final Report. D. S. Carder and W. V. Mickey (Coast and Geodetic Survey, Washington, D. C.). Dec. 1960. 90p. Project COWBOY. Contract AT(29-2)-746.

Includes Appendix A: LONG PERIOD SEISMIC PROGRAM. Paul W. Pomery and Jack Oliver (Columbia Univ., Palisades, N. Y. Lamont Geological Observatory).

The ratio of transient earth particle displacements resulting from the detonation of high explosives in a tamped bore hole (coupled) to detonations in a spherical cavity (uncoupled) in salt varied from about 20 for the scaled ratio of Shots 15/14 to 180 for Shots 11/10 at a distance of 22,100 ft from the source. Transient earth particle displacements (A_μ), measured in microns, varied with the yield (Y) in pounds from $Y^{0.73}$ to $Y^{1.16}$. The distance (D) in feet varied with the earth particle displacements from $D^{-2.1}$ to $D^{-3.5}$ for the recorded seismic waves. Observed frequencies varied from about 2 to 120 cps. The diverse seismograph recording systems were sensitive to frequencies from less than 1 to 100 cps. Detector to source distances ranged from 761 to 323,830 ft with readable energy for the 1000-lb tamped shots received to 88,100 and the 1,900-lb sphere shot to 44,700 ft. (auth)

7129 (USNRDL-TR-480) ABOVE- AND BELOW-SURFACE EFFECTS OF ONE-POUND UNDERWATER EXPLOSIONS—HYDRA I. J. W. Hendricks and D. L. Smith (Naval Radiological Defense Lab., San Francisco). Oct. 18, 1960. 246p.

A detailed description is presented of phenomena associated with the underwater detonation of 1-lb pentolite high-explosive charges. The major above- and below-surface configurations are identified. Their relationship to each other and their variation as a function of time and charge depth are given. High-speed motion pictures were employed in the observations. Other instrumentation was employed to determine the amount and distribution of water and detonation products projected above the surface. A radioactive tracer was introduced into the charges to facilitate observation of the detonation products. Data are presented in graphical form and in the form of selected photographic sequences. (auth)

7130 THE FIRST FIVE YEARS AT LUCAS HEIGHTS. J. P. Baxter (University of New South Wales, Kensington, Australia). Atomic Energy 3, 2-4(1960) Oct.

Discussions presented are: a review of the first five years at Lucas Heights; the impact of the atomic energy industry on biological research; the production of radioisotopes; progress on the nuclear power plant for the Antarctic being built by the United States; levels of Sr^{90} in the Australian environment; production of Co^{60} at Lucas Heights; the place of the engineer–scientist in the field of nuclear energy; applications of radioisotopes in medical research; and prospects for competitive nuclear power. (B.O.G.)

7131 INTERNATIONAL CONFERENCE ON JUDICIAL AND ADMINISTRATIVE SAFETY PROBLEMS IN THE PEACEFUL USE OF NUCLEAR ENERGY. R. Gautron

(Harvard Univ., Cambridge, Mass.). Bull. inform. A.T.E.N., No. 25, 12-20(1960) Sept.-Oct. (In French)

A summary is presented of the reports of the second day (indemnification of workers for radiation exposure) of the International Conference, Brussels, September 5 to 8, 1960. The treatment points out the problems of the employer, the principles of the OECE Convention, the controls of social security, and the position of the insurance pools. (T.R.H.)

7132 "FIVE-YEARS OF NUCLEAR RESEARCH AND TECHNOLOGY IN THE GERMAN DEMOCRATIC REPUBLIC." K. Rambusch. Kernenergie 3, 932-40(1960) Oct.-Nov. (In German)

A summary of nuclear energy development in the German Democratic Republic (DDR) since 1955 is presented. The topics include: scientific council on peaceful uses of atomic energy; board for nuclear research and technology; central institute for nuclear physics; nuclear physics and nuclear technology work in other scientific organizations; construction of the first nuclear power plant in the DDR; use of radioactive and stable isotopes; development of instrument production; measures for radiation protection; developments in nuclear physics, nuclear chemistry, and nuclear technology; and international cooperation. (T.R.H.)

7133 THE SCIENTIFIC OBJECTIVES OF THE ABLE-5 PROGRAM. Saul Altshuler, John Lindner, Felix Schweizer, Richard Wagner, and Richard Condon (Space Technology Labs., Inc., Los Angeles). Phys. Today 14, 20-7(1961) Jan.

The ABLE-5 satellite was designed as a lunar scientific observatory to investigate some important aspects of space physics. It contains flux-gate and search-coil magnetometers, a set of radiation sensors, and a micrometeorite counter. The objective of the sensors is to acquire information about the distribution of magnetic fields, the spectral density of charged particles, and meteoritic statistics. The energy ranges of the sensors are 50 kev to >13 Mev and 200 ev to >75 Mev for electrons and protons, respectively. ABLE-5 should add significantly to the understanding of data attained from previous satellites and radiation will be examined during a different part of the solar cycle. (B.O.G.)

7134 RADIATION ENVIRONMENT IN SPACE. Homer E. Newell and John E. Naugle (National Aeronautics and Space Administration, Washington). Science 132, 1465-72(1960) Nov. 18.

Information is summarized on the various types of radiation that were found in space using satellites and space probes. The physical natures of the radiations are discussed, together with the mechanisms by which the radiation interacts with matter. Dosage levels are defined. The salient factors in the choice of shielding are discussed. An assessment is made of the importance of radiations in space to space missions. (B.O.G.)

7135 PROCEEDINGS OF THE AMERICAN POWER CONFERENCE, MARCH 29, 30, 31, 1960, CHICAGO, ILLINOIS. VOLUME XXII. Chicago, Illinois Institute of Technology. 1960. 902p. $10.00.

Papers presented at the 1960 meeting of the American Power Conference in Chicago on March 29 to 31 are given. A variety of topics relevant to generation, transmission, and utilization of power are covered. Separate abstracts have been prepared for 10 of these papers having nuclear aspects. (D.L.C.)

7136 THE ISOTOPE INDEX. THE COMPLETE PURCHASING GUIDE TO THE ISOTOPES. STABLE–RADIOACTIVE LABELED COMPOUNDS. International Edition, 1960-61. Volume 5. J. L. Sommerville, ed. Indianapolis, Scientific Equipment Co., 1960. 143p. $5.00 (U. S. and Canada), $5.00(foreign).

A list is presented of available stable and radioactive isotopes and labeled compounds. Data are included on the supplier, specific activity of the preparation, typical prices, and other pertinent items. (C.H.)

7137 ATOMIC ENERGY AND LAW. Interamerican Symposium on Legal and Administrative Problems Connected with Peaceful Atomic Energy Programs, San Juan, Puerto Rico, 16-19 November 1959. Jaro Mayda, ed. Rio Piedras, Puerto Rico, University of Puerto Rico, 1960. 266p.

Papers presented at the Interamerican Symposium on Legal and Administrative Problems Connected with Peaceful Atomic Energy Programs held in San Juan, Puerto Rico, on Nov. 16 to 19, 1959, are given. The discussions cover such topics as uses of radioisotopes, waste disposal, regulation, liability, the legal framework of U. S., and international regulations. (D.L.C.)

7138 IMPROVEMENTS IN UTILIZATION OF NUCLEAR ENERGY. Thayer Lindsley. British Patent 856,900. Dec. 21, 1960.

A plan for utilizing nuclear energy to distil fresh water from sea water is outlined in which a small fission bomb is detonated underground, sea water is led into a subterranean region heated by the molten blister formed in the explosion, and the resulting steam is recovered and condensed to fresh water. Various methods of leading the sea water to the hot region and recovering the steam are described, e.g., seepage of sea water in coastal regions, wells, heat-conducting bars, etc. Schematic drawings illustrating the plan are included. (D.L.C.)

7139 UTILIZATION OF NUCLEAR ENERGY. William Paul Drews, Hampton Gaskill Corneil, and Andrew Dillard Suttle, Jr. (to Esso Research and Engineering Co.). British Patent 856,904. Dec. 21, 1960.

A method for utilizing energy from underground explosions is outlined in which a nuclear device is exploded in a water-containing cavity in a salt dome or some other competent geological formation and the steam generated therefrom used to generate power and then passed into a second cavity for storage. This process can be reversed, i.e., a second nuclear device is exploded in the second cavity and the spent steam passed into the first cavity, and thus continuous power generation may be obtained. The cavity after explosion may be kept in a closed position for 5 to 10 days to allow the short-lived radioisotopes to decay, or a heat-exchanger system may be used to extract the heat from the steam. A processing unit may also be used to trap solid particles, remove gaseous impurities, and recombine H_2, O_2, and H_2O_2 in the steam. Various ways of inducing cavities in formations, e.g., by leaching with water, are described, and a list of fusion reactions suitable for producing the explosion is presented. Variants of this method are treated in detail, especially those which minimize the shock waves. An example is given in which a 20-megaton fusion bomb generated power for 40 weeks with a total output of 4×10^9 kwh at 18% efficiency. Schematic drawings are included. (D.L.C.)

7140 RADIOACTIVE ISOTOPE PRODUCTION. (to Esso Research and Engineering Co.). British Patent 857,219. Dec. 29, 1960.

Radioisotopes may be produced in large yields and with high specific activities by exploding a nuclear device in an

underground geological formation, preferably a salt dome formation. Some fusion reactions suitable for this purpose are listed. After the explosion the site may be prepared for radioisotope recovery by passing water into it, which lowers the temperature and converts the products into the aqueous form; the solutions are then withdrawn for chemical processing. Alternatively a reactive coolant may be used which reacts with part of the products to form volatile compounds that may be easily recovered; examples of such coolants are phosgene, CCl_4, liquid halogens, etc. Specific methods for producing Co^{60}, plutonium, bromine isotopes, C^{14}, and chlorine isotopes in the above manner are described. The advantages of this method of radioisotope production over those using accelerators and reactors are given. Drawings illustrating the preferred manner for initiating the process and recovering the products are included. (D.L.C.)

BIOLOGY AND MEDICINE

General and Miscellaneous

7141 (CEX-58.8) COMPARATIVE NUCLEAR EFFECTS OF BIOMEDICAL INTEREST. Clayton S. White, I. Gerald Bowen, Donald R. Richmond, and Robert L. Corsbie (Lovelace Foundation for Medical Education and Research, Albuquerque, N. Mex. and Division of Biology and Medicine, AEC). Sept. 1960. 83p.

Selected physical and biological data bearing upon the environmental variations created by nuclear explosions are presented. Emphasis is placed upon the early consequences of exposure to blast, thermal radiation, and ionizing radiation to elucidate the comparative ranges of the major effects as they vary with explosive yield and as they contribute to the total hazard to man. A section containing brief definitions of the terminology employed is followed by a section that utilizes text and tabular material to set forth events that follow nuclear explosions and the varied responses of exposed physical and biological materials. Finally, selected quantitative weapons-effects data in graphic and tabular form are presented over a wide range of explosive yields to show the relative distances from Ground Zero affected by significant levels of blast overpressures, thermal fluxes, and initial and residual penetrating ionizing radiations. However, only the early rather than the late effects of the latter are considered. 52 references. (auth)

7142 (NYO-9643) FIRST TECHNICAL REPORT ON ATOMIC ENERGY COMMISSION BLOOD CELL SCANNER. Report No. 5778. K. Preston, Jr. and N. F. Izzo (Perkin-Elmer Corp., Norwalk, Conn.). Nov. 1, 1960. 80p. Contract AT(30-1)-2573.

A breadboard television microscope and associated data processing system was developed for scanning blood smears to determine the feasibility of semiautomatic machine identification of binucleate lymphocytes. Initial studies are described on blood smear preparation techniques as well as the results of a survey of optical and electronic scanning systems. Detailed data are presented on the absorption and fluorescent emission spectra of biological stains and on their staining ability. Statistical data on the distribution of configurations of white cells in typical blood smears are also presented. (auth)

7143 (ORO-358) FINAL SCIENTIFIC REPORT ON [MEDICAL APPLICATIONS OF RADIOISOTOPES]. P. F. Hahn (Meharry Medical Coll., Nashville). July 12, 1960. 42p. Contract AT(40-1)-269.

Results are summarized on 560 patients with malignant disease treated with radiogold or silver-coated radiogold colloids. Observations made in the course of the therapeutic management of chronic leukemias are included. It was concluded that a single intravenous administration of radiogold colloid offers as simple and satisfactory a method of treating leukemia as is available at this time. Results are reported from preliminary studies in dogs on the therapy of bronchogenic tumors. Attempts to induce tumors of the lung in dogs are reported. Studies are reported on the control of lymphatic drainage after pneumonectomy by the injection of silver-coated gold colloid. Experiences in the treatment of advanced bronchogenic carcinoma with radioactive colloids administered by the intrabronchial route are reported. Results are reviewed from long-term studies on the effects of Fe^{59} and Fe^{55} in dogs; intracavitary therapy with radiocolloids; the treatment of pleural effusions with silver-coated Au^{198} colloids; the treatment of leukemia in mice with radioactive gold colloids alone and combined with other agents; tracer studies of phagocytic processes in the animal body; the distribution of gold in the central nervous system following the administration of radioactive colloidal gold; the tolerance to intraventricular injections of colloidal gold and to injections directly into the brain; the feasibility of nerve destruction by the intraneural and perineural injection of large doses of high specific activity radiogold colloids; the treatment of prostate and bladder carcinoma with radioactive gold; the development of cirrhosis and ascites in dogs following administration of colloidal radioactive gold; studies of protein deficiency in dogs which received chronic massive internal irradiation due to intravenous administration of radiogold; the prophylactic use of radiocolloids postoperatively to prevent seeding of cancer; studies of hepatic visualization following the administration of colloidal radiogold; studies on palladium colloids with antigenic protective colloid in an attempt to concentrate antigen in the reticuloendothelial system; and miscellaneous studies. A list is included of 76 publications resulting from this contract. (C.H.)

7144 (TID-6450) RIBONUCLEOPROTEIN FROM A RAT TUMOR, THE JENSEN SARCOMA. I. THE EFFECT OF MAGNESIUM BINDING ON ULTRACENTRIFUGAL AND ELECTROPHORETIC PROPERTIES. Mary L. Petermann (Sloan-Kettering Inst. for Cancer Research, New York and Cornell Univ., New York. Medical Coll.). 1959. 34p.

A purified ribonucleoprotein was prepared from the cytoplasm of a rat tumor, the Jensen sarcoma. This substance undergoes association-dissociation reactions, in response to changes in pH, ionic strength, and the magnesium concentration of the solvent, which are similar to those of other ribonucleoproteins of either plant or animal origin. Magnesium binding was studied by the equilibrium dialysis method. The tightness of the binding is dependent on the pH and ionic strength of the solvent. For evaluation of other effects of pH and ionic strength the magnesium content of the ribonucleoprotein should be kept constant. At pH 8.0 and ionic strength 0.10 the electrophoretic mobility is a linear function of the bound magnesium only as long as the ribonucleoprotein remains in the 83 S form. When dissociation or association occurs, the changes in mobility become quite complex, suggesting that changes in electrical charge are being offset by changes in the frictional coefficient. (auth)

7145 (TID-6451) A STUDY OF THE PENETRATION OF MAMMALIAN CELLS BY DEOXYRIBONUCLEIC ACIDS. Ellen Borenfreund and Aaron Bendich (Cornell Univ., New

York. Medical Coll.). [1960?]. 22p. Contract AT(30-1)-910.

Tritium-labeled deoxyribonucleic acid (DNA) from pneumococci and from human leukocytes was added to growing cultures of HeLa cells at 37°C. Autoradiography revealed an extensive localization of H^3 in the nuclear regions. The label could not be removed by treatment with ribonuclease or dilute perchloric acid, but quantitative removal from the cells could be effected with deoxyribonuclease. Chemical and radioactivity determinations on nucleic acids isolated from the exposed HeLa cells revealed the presence of H^3 in all four DNA bases. About 12 μg of tritiated DNA was recovered from 6×10^6 HeLa cells which had been exposed for 24 hr to 240 μg of the human DNA. From this, it is concluded that the amount of DNA, or its degradation products, taken up by the cells was equivalent to at least 10 per cent of the normal HeLa cell complement. (auth)

7146 (TID-11578) PRELIMINARY STUDIES ON THE PHOTOREACTIVATION OF ULTRAVIOLET-ENHANCED NONRECIPROCAL AND RECIPROCAL RECOMBINATION IN SACCHAROMYCES. A Preliminary Report. David Pittman (Southern Illinois Univ., Carbondale. Biological Research Lab.). 1960?. 9p. Contract AT(11-1)-424.

Results are reported from a study of the effects of ultraviolet radiation on the induction and photoreactivation of recombination in diploid yeasts. The data indicate that ultraviolet induction of nonreciprocal recombination is photoreactivated, whereas induction of reciprocal recombination is not photoactivated. (C.H.)

7147 (TID-11579) ESTIMATES OF STANDING CROP OF PLANKTON IN CLEAR LAKE, IOWA (thesis). Lawrence Frederick Small (Iowa State Coll., Ames). 1959. 37p. Contract AT(11-1)-59:11.

Some estimates of standing crops of phytoplankton, and methods of obtaining these estimates more quickly than by enumeration, were investigated at Clear Lake, Iowa, during the summer of 1958. (auth)

7148 HEURISTIC GLIMPSES INTO THE EVOLUTION OF RADIATION THERAPY, PARTICULARLY IN REFERENCE TO GYNECOLOGIC CANCERS, CALDWELL LECTURE, 1960. Traian Leucutia (Harper Hospital, Detroit). Am. J. Roentgenol., Radium Therapy Nuclear Med. 85, 3-20(1961) Jan.

Developments in the evolution of radiation therapy of gynecologic cancers are reviewed. Results are summarized from a series of 553 cases of carcinoma of the endometrium treated by radiation therapy and surgery in various combinations. The three methods used include preoperative irradiation with intracavitary radium and external x rays, hysterectomy six to eight weeks later, and postoperative irradiation with external x rays two to three weeks after the operation; hysterectomy and 2 or 3 courses of postoperative irradiation with external x rays, associated very rarely with intravaginal radium, at intervals of eight to ten weeks from each other; and irradiation alone in the inoperable cases. Over-all five year survivals of 61% were obtained in a group of selected patients treated by a combination of surgery, preoperative irradiation with intracavitary radium or equivalent radioactive substances, and external x or γ rays followed by total hysterectomy and bilateral oophorectomy, and supplemented, when necessary, with a second course of external radiation therapy. (C.H.)

7149 THE USE OF A VAGINAL APPLICATOR AS AN ADJUNCT TO THE TREATMENT OF CARCINOMA OF THE CERVIX. Joseph E. Whitley, Damon D. Blake, Richard L. Witcofski, and I. Meschan (North Carolina Baptist Hospital, Winston-Salem and Bowman Gray School of Medicine, Winston-Salem). Am. J. Roentgenol., Radium Therapy Nuclear Med. 85, 29-32(1961) Jan.

A description of an aluminum broomstick vaginal applicator for use in the treatment of vaginal extension of carcinoma of the cervix is given. Indications and techniques for its use are discussed. (auth)

7150 FOCUSED GRID TELECOBALT THERAPY. David M. Gould, John W. Lane, and Walter Mauderli (Univ. of Arkansas, Little Rock). Am. J. Roentgenol., Radium Therapy Nuclear Med. 85, 38-52(1961) Jan.

A series of 87 cases of advanced cancer was treated with focused-telecobalt-grid therapy. Fifty-one patients experienced appreciable to striking palliation. No palliation was observed in 36 patients. The best palliation results were in patients with carcinoma of the bladder and the least impressive in patients with carcinoma of the lung. (auth)

7151 MOVING-BEAM THERAPY WITH COBALT 60: ITS ADAPTABILITY TO THE LESION SHAPE TO BE TREATED. Jane Howarth and C. W. Wilson (Westminster Hospital, London). Am. J. Roentgenol., Radium Therapy Nuclear Med. 85, 53-8(1961) Jan.

A series of moving beam techniques for treating a variety of disease sites of different areas and shapes, achieved by individual patient planning, is described. The very wide range of dose contour patterns which can be produced is arrived at by using multiple arcs and centers of rotation; thus a greater number of tumor sites may best be treated by a rotation technique than would first appear. (auth)

7152 COBALT 60 TAGGED B_{12} AS A DIAGNOSTIC TOOL IN THE GENERAL ISOTOPE LABORATORY. D. R. Germann (Univ. of Kansas, Kansas City). Am. J. Roentgenol., Radium Therapy Nuclear Med. 85, 59-61(1961) Jan.

In the past there have been articles indicating that the excretion percentage of Co^{60}-tagged B_{12} may be abnormal by as much as 13%. The distribution of results in our relatively large series would imply that only patients excreting 2% or less are definitely abnormal. Those excreting 3 to 4% are a border-line group which may be abnormal but usually is found to be normal, with some technical error occurring in the test. Certainly 5% or above should be considered normal. The test is extremely valuable in the evaluation of patients with neurologic, hematologic, and obscure gastrointestinal disease. (auth)

7153 SCINTISCANNING OF DOG KIDNEYS USING DIODRAST I^{131}. Mary C. Morgan, H. L. Barton, Ethel E. Erickson, and J. R. Risser (Veterans Administration Hospital, Houston, Tex. and Rice Inst., Houston, Tex.). Am. J. Roentgenol., Radium Therapy Nuclear Med. 85, 123-7(1961) Jan.

Scintiscanning of the kidneys of normal dogs was performed by use of 135 to 465 μc diodrast I^{131} administered intravenously in divided doses during the scanning procedure. Radioassay procedures based on blood retention of radioactivity revealed a total body radiation exposure during the first 24 hr of 178 mrad/mc in the dog with the greatest blood retention. Excretion studies revealed nearly complete elimination of the administered radioactivity within 3 days, the major portion occurring in the first 24 hr. No adverse effects on peripheral blood count or on tissues examined after autopsy could be found in animals given 400 μc diodrast I^{131} intravenously or subcutaneously. The

method appears to be feasible for human application where doses of the order of 2 to 2.5 mc are anticipated and where thyroid blockage of I^{131} uptake will be necessary. (auth)

7154 PROTEIN SYNTHESIS IN MICROORGANISMS. G. David Novelli (Oak Ridge National Lab., Tenn.). Ann. Rev. Microbiol. 14, 65-82(1960).

A review is presented of results of recent studies on the mechanism of protein synthesis in microorganisms. 127 references. (C.H.)

7155 LECITHIN FORMATION BY METHYLATION OF INTACT PHOSPHATIDYL DIMETHYLETHANOLAMINE. Camillo Artom and Hugh B. Lofland, Jr. (Wake Forest Coll., Winston-Salem, N. C.). Biochem. Biophys. Research Communs., 3, 244-7(1960) Sept.

Results are reported from tracer studies of lecithin formation by methylation of intact phosphatidyl dimethylethanolamine (DME). After incubation of C^{14} labeled DME with rat liver slices, the isotope was found to be present in the DME as well as in the choline moiety of the phospholipids. Results are tabulated from typical experiments. Possible reaction mechanisms involved are discussed. (C.H.)

7156 AN EXPERIMENTAL METHOD FOR COMPARING TREATMENTS OF INTACT MALIGNANT TUMOURS IN ANIMALS AND ITS APPLICATION TO THE USE OF OXYGEN IN RADIOTHERAPY. R. H. Thomlinson (Hammersmith Hospital, London). Brit. J. Cancer 14, 555-76 (1960) Sept.

A technique was developed for growing transplantable malignant tumors in the subcutaneous tissue of the rat in such a way that they remain localized until they have grown to a suitable size for testing the effects of different treatments. The course of the tumors was followed in situ by daily measurement. Comparisons were made of the effects of single doses of 2000 rads and 4000 rads of 250-kv x rays under three different conditions of oxygenation of the tumor: with the tumor made anoxic by clamping the circulation; with the tumor aerated with its circulation intact and the rat breathing air at atmospheric pressure; and with the tumor oxygenated with the animal breathing oxygen at 4 atm pressure. The effect of 2000 rads given in air approximately equals that of 4000 rads to the anoxic tumor and the effect of 2000 rads in oxygen approximately equals that of 4000 rads in air. These results indicate that when the rat breathes air there are cells in the tumor protected from radiation injury by hypoxia and that after radiation in air such cells can regenerate the tumor and their radiosensitivity can be enhanced by the breathing of oxygen at high pressures. The pathological basis of these conclusions suggests that they apply equally to many forms of human cancer. (auth)

7157 THE USE OF STANDARD ISODOSE DISTRIBUTIONS WITH HIGH ENERGY RADIATION BEAMS. THE ACCURACY OF A COMPENSATOR TECHNIQUE IN CORRECTING FOR BODY CONTOURS. E. J. Hall and R. Oliver (Churchill Hospital, Oxford). Brit. J. Radiol. 34, 43-52 (1961) Jan.

The use of metal compensators mounted at 20 cm from the skin has proved to be a simple and practicable method of correcting for the irregularity of the patient's contour in high energy radiotherapy. The full skin-sparing advantage of high-energy radiation is preserved, and at the same time the standard isodose curves can be applied directly to determine the dose distribution within the patient. Compensators are made so that the thickness of aluminum parallel to the direction of the central ray is equal to $0.88\ h/\rho$, where h is the corresponding thickness of unit density material replaced and ρ is the density of the aluminum. This compromise provides satisfactory compensation for the conditions of normal clinical use. At a depth of 5 cm in a patient, the dose will not be in error by more than $\pm 2\%$ for the whole range of field sizes and amount of compensation encountered. At the same time, dose at the surface will not be more than 0 to 5% low, and at a depth of 10 cm not more than 0 to 5% high. To avoid errors resulting from the geometry of the system, the density of the compensator material should have the optimum value given by the expression: $\rho = 0.88\ b/a$, where b is the source-skin distance of the particular unit and a is the distance from the source at which the compensator is mounted. This value would be 1.32 g per cc for the Oxford cobalt unit. In practice it is convenient to use a material such as aluminum or brass, because it is easily machined and compensator pieces can be cleaned and reused indefinitely. The additional errors of compensation introduced by the use on our unit of aluminum instead of a material with an ideal density do not exceed $\pm 4\%$ for the vast majority of cases met with in clinical practice. The use of brass results in somewhat larger errors. For a cobalt unit with a source 2 cm in diameter, compensators may be built up from a stock of aluminum columns, $\frac{3}{8}$ in. square section, available in 12 standard lengths, in steps equivalent to 1 cm of tissue. This provides a sufficiently fine compensation, with up and down variations in transmitted dose of only a few per cent from the ideal continuous compensator. The cross-section of the columns would need to be reduced for use with a machine with a point source. The effect of beam divergence cannot be ignored for units working at 60 or 80 cm source-skin distance, with compensators mounted 16 to 20 cm from the skin, without introducing appreciable errors for steeply sloping contours. The compensator should be scaled down to allow for its position in the beam. (auth)

7158 PREVENTION OF INSULIN-I^{131} ADSORPTION TO GLASS. Ralph Wiseman, Jr. and Barbara E. Baltz (Veterans Administration Medical Teaching Group Hospital, Memphis). Endocrinology 68, 354-6(1961) Feb.

It was shown that human serum albumin in a final concentration of 0.5 mg/ml can effectively prevent insulin-I^{131} from being adsorbed to glass surfaces. Of the insulin-I^{131} introduced to the system, 95.8% was recoverable when precipitated with 20% trichloroacetic acid after a period of incubation for 30 min when protected by this concentration of albumin. It appears that human serum albumin can be reliably employed to protect insulin-I^{131} when dilutions of standards or working solutions are made for radioactivity measurements. (auth)

7159 A HERITABLE CHANGE IN RADIATION RESISTANCE OF STRAIN L MOUSE CELLS. P. O. W. Rhynas and H. B. Newcombe (Atomic Energy of Canada Ltd., Chalk River, Ont.). Expti. Cell Research 21, 326-31 (1960) Nov.

Repeated exposure of mass cultures of L strain mouse cells to high doses of ionizing radiation resulted in new strains that had an increased resistance to x rays. After a cumulative dose of 5000 r spread over five months, growth of these cell lines following a test exposure to 2000 r was compared with that of cultures of the control strain. After the test exposure, growth of the preirradiated lines was resumed much sooner than in the controls. The resistant cell lines all had a lower average chromosome number with a wider spread of numbers than had the parental control line. (auth)

7160 A COMBINATION OF SPECIFIC ANTI-TUMOUR THERAPY AND X-RAY IRRADIATION. P. Koldovský and Alena Lengerová (Inst. of Biology, Czechoslovak Academy of Sciences, Prague). Folia Biol. (Prague) 6, 441-3(1960). (In English)

An investigation was made of the possibility of treating malignant disease in mice by a combination of radiation and immunity, using specific anti-tumor immunity which does not react against the recipient's normal tissues. An evaluation of results led to the conclusion that the combination of whole-body irradiation and immunotherapy significantly prolongs the survival time of mice with experimental tumors. (C.H.)

7161 HISTOLOGICAL AUTORADIOGRAM OF SOLUBLE COMPOUNDS. Tao Huang (Univ. of Illinois Coll. of Medicine, Chicago). Intern. J. Appl. Radiation and Isotopes 8, 234-6(1960) Oct. (In English)

An autoradiographic technique for histological sections was developed for the detection of soluble as well as insoluble radioactive tracers in percutaneous absorption problems. In this technique, skin containing the tracer is fixed on a microtome holder with a gel, frozen in liquid nitrogen, placed in a −20°C cryostat, and cut into sections which are then mounted on slides. The slides are labeled with C^{14}-containing ink and pressed into contact with an emulsion to produce the autoradiogram. After exposure, the section and emulsion are processed separately, the section undergoing fixing and staining. Finally, the section and autoradiogram are aligned with each other by viewing through a magnifying glass the labeled ink on the slide and the corresponding darkening on the emulsion. Photographs are included illustrating guinea pig skin prepared in this manner. Possible improvements of the technique are discussed. (D.L.C.)

7162 SCINTILLATION SCANNING IN DIFFERENTIAL DIAGNOSIS. Frederick J. Bonte, J. S. Krohmer, C. H. Tseng, and Marion C. L. Baldwin (Univ., of Texas, Southwestern Medical Coll., Dallas and Parkland Memorial Hospital, Dallas). J. Am. Med. Assoc. 175, 221-4(1961) Jan. 21.

Scintillation scanning performed after injection of a tracer dose of I^{131}-tagged human serum albumin is a safe, rapid substitute for roentgen aortography in the differential diagnosis of midline thoraco-abdominal masses. Blood pools can be demonstrated within known aneurysms. Solid tumors do not show the presence of blood pools, and aneurysms filled with clot would not be expected to do so. Diagnostic results were obtained with the radioisotope scanning test in 7 of 8 cases of midline thoraco-abdominal masses of obscure origin. Findings were inconclusive in the remaining case. (auth)

7163 A RAPID METHOD FOR PREPARING WASHED RED CELLS TAGGED WITH CHROMIUM. Chalom A. Albert, Harold N. Eccleston, Jr., Amir Rafii, Charles H. Hunter, Evelyn E. Henley, and Solomon N. Albert (District of Columbia General Hospital, Washington, D. C.). J. Lab. Clin. Med., 54, 300-3(1960) Aug.

The plastic centrifuge bag for washing tagged cells simplified and eliminated sources of contamination in the manipulation of cells during tagging and washing procedures. An angle centrifuge head adapted to the regular clinical centrifuge reduces the time necessary to obtain adequate separation of tagged cells by one-half. (auth)

7164 RAPID ASSAY PROCEDURES FOR TRITIUM-LABELED WATER IN BODY FLUIDS. B. E. Vaughan and E. A. Boling (Naval Radiological Defense Lab., San Francisco, Calif.). J. Lab. Clin. Med. 57, 159-64(1961) Jan.

Two methods are presented for the accurate radioassay of tritiated water in connection with body-water determinations. Both methods are applicable to body fluids in general. Considering factors of accuracy, simplicity, and time, the method of choice is rapid vacuum sublimation. This requires a 0.5 to 2 ml sample and is carried out in a single, individual glass unit. In cases where vacuum sublimation are not feasible, internal standardization will give results approaching similar accuracy provided an auxiliary determination is made of the water content of the original sample. For twelve active, healthy men the mean exchangeable body water ±1 standard deviation was 51 ± 5 l. Analogously body weight for this group was 102 ± 9 kilograms. (auth)

7165 NUCLEAR REACTOR RADIOLOGY IN CLINICAL MEDICINE. Lee E. Farr (Brookhaven National Lab., Upton, N. Y.). Northwest Med. 1121-33(1960) Sept. (BNL-4841).

Reaction mechanisms involved in the therapy of malignant tumors with neutron capture are discussed. The development of clinical methods in neutron-capture therapy is outlined. Case histories are included for patients with intracranial tumors treated with neutron-capture therapy. (C.H.)

7166 EFFECT OF DEUTERIUM OXIDE ON GROWTH OF HeLa, L AND L-5178Y CELLS. Lionel A. Manson, Vittorio Defendi, Richard W. Hartzell, Jr., and David Kritchevsky (Wistar Inst. of Anatomy and Biology, Philadelphia). Proc. Soc. Exptl. Biol. Med. 105, 481-3(1960) Dec.

The effect of D_2O on growth of three stable mammalian cell lines (HeLa, L, and L-5178Y) was investigated. As D_2O concentration was increased, all cells showed increased water content and dry weight and a slower growth rate. Cytological investigations showed an increase in number of multinucleated cells and a moderate increase in sudanophilic material. No significant changes in nucleic acid content were demonstrable with the staining technics used. (auth)

7167 KERNICTERUS IN JAPANESE INFANTS. II. PATHOLOGIC DATA IN 25 CASES OF KERNICTERUS AND IN 20 CASES OF SYSTEMIC ICTERUS WITHOUT KERNICTERUS. Clara Margoles (Armed Forces Inst. of Pathology, Washington, D. C.), Kenji Katami, William C. Moloney, Angel Pentschew, Wataru W. Sutow, and Webb Haymaker. World Neurol. 1, 254-71(1960) Sept.

Clinical and laboratory data are reviewed on 45 infants with systemic icterus born in Hiroshima. An attempt was made to determine why 25 of the infants developed kernicterus while 20 did not. The pattern of involvement and the histologic changes in the central nervous system in the kernicterus group were not essentially different from those in cases with Rh or ABO blood group sensitization regardless of the maturity of the infant. In the nonkernicterus group, no histologic changes were found in the central nervous system. The degree of systemic icterus observed at autopsy was, in the aggregate, greater in the kernicterus than in the nonkernicterus group. There were, however, a few kernicterus cases in which systemic icterus was slight and several nonkernicterus cases in which systemic icterus was moderate or pronounced. It is concluded that some factor other than hyperbilirubinemia is responsible for damage of the central nervous system in kernicterus. There was no evidence to suggest that the development of icterus in the infants was a biological effect of the explosion of an atomic bomb at Hiroshima. (C.H.)

7168 ELEMENTS OF APPLIED RADIOBIOLOGY. (Éléments de Radiobiologie Appliquée). Roland Buchet and G. Breitman. Paris, Masson Et Cie, Éditeurs, 1960. 195p.

A survey is presented of the effects of radiation on cells and methods of protection. It begins with physical generalities such as matter, energy, and radiation. Section II treats interactions of matter and ionizing radiations including penetration, absorption, ionization, measuring units, and mechanisms of action. Other sections deal with experimental radiobiology, cellular radiobiology, delayed effects, and methods of prevention and protection. (T.R.H.)

7169 APPARATUS FOR THE RADIO-ACTIVE RADIATION TREATMENT OF THE INNER CAVITIES OF A BODY. Willy Büsch. British Patent 857,992. Jan. 4, 1961.

A device for radiation treatment of body cavities is designed comprising a resilient gut or gullet tube in which there is a radiation source embedded in a completely closed tube. The closed tube is movable relative to the resilient tube from outside by means of a fine wire or thread. With this device, it is possible to regulate the dose by varying the distance from the radiation source to the object and to extend the radiation effect linearly over a large distance, thereby obtaining a better effect in depth and on tumors. The radiation source may also be made flexible. (D.L.C.)

Biochemistry, Nutrition, and Toxicology

7170 (TID-11320) FISSION PRODUCT METABOLISM AND RESPONSE IN LABORATORY AND DOMESTIC ANIMALS. Progress Report and Proposal for Continuation [covering Period] April 1, 1960–January 31, 1961. C. L. Comar, R. H. Wasserman, F. W. Lengemann, D. N. Tapper, and A. R. Twardock (New York. State Univ. Veterinary Coll., Ithaca). 20p. Contract AT(30-1)-2147. OTS.

The construction of a radiation biology field laboratory and a radiation exposure field is reported. Specifications were completed for a whole-body radiation counter for humans and medium-sized animals such as sheep, goats, and swine. A detailed review was prepared on strontium-calcium metabolism in man and animals. Bibliographies were prepared on the metabolism of cesium, potassium, iodine, and barium, and on the response of the control nervous system to radiation. A compilation was prepared of various programs devoted to the analysis and sampling of food chains for evaluation of environmental contamination. Progress is reported in studies on the relationship between blood levels of calcium and strontium and secretion into milk; an active transport system for calcium absorption studies; the interrelationship between over-all metabolism of the animal and the absorption and deposition of Ca^{45} and Sr^{85} in rats; a possible parathyroid effect on the intestinal absorption of Ca^{45} and Sr^{85} in rats; the effects of whole-body x irradiation on the absorption of Sr^{85} and Ca^{45}; tracer studies on the calcification of bone grown in vitro; the incorporation of I^{131} into chicken eggs; tracer studies on the comparative metabolism of cesium and potassium in mature and foetal rats; the evaluation of dietary intake of strontium and calcium by assay of urine; and the development of a method for analysis of total accumulation curve upon continuous uptake in studies on metabolism. A list is included of 30 publications resulting from studies performed under this contract. (C.H.)

7171 (UCRL-6168) URINALYSIS FOR CURIUM BY ELECTRODEPOSITION. Isabelle Dupzyk and Max W. Biggs (California. Univ., Livermore. Lawrence Radiation Lab.). Dec. 1960. 18p. Contract W-7405-eng-48.

A urinalysis method was developed for the determination of curium by electrodeposition. The urine is wet ashed, and the curium coprecipitated with bismuth phosphate, then lanthanum fluoride, and finally lanthanum hydroxide. The curium is separated from the lanthanum carrier using Dowex-50 colloidal ion exchange resin. Electrodeposition on a stainless-steel or platinum disc gives a uniform film suitable for pulse-height analysis or low-background proportional counting. Final analysis of weak samples is done by radioautography. Curium recoveries of approximately 45% are obtained. Quantities of the order of 0.2 dpm can be detected by this method. (auth)

7172 VENOUS TRANSPORT OF Na^{22} FROM HEALING FRACTURES IN THE RABBIT TIBIA. Lars Göthman (Karolinska Institutet, Stockholm). Acta Radiol. 54, 469-82(1960) Dec. (In English)

The venous transport of Na^{22} injected into the medullary cavity of undamaged and fractured tibias was studied in 33 rabbits. The radioactivity was determined in samples of venous blood obtained from the femoral vein and from the nutrient vein, both the k-value or disappearance constant; measured by a modification of Kety's formula, and the percentage of transported radioactivity being ascertained for each of the two outflow pathways. The results suggest that an increase in the regional circulation outside the tibia takes place in 3- to 4-week old fractures and that the circulation in the medullary cavity increases at a later stage in the healing process. (auth)

7173 THE EXCRETION OF RADIOACTIVE IODIPAMIDE (CHOLOGRAFIN) BY NORMAL AND CIRRHOTIC MALES. Gustaf E. Engstrom, Joseph L. Rabinowitz, Herbert D. Strauss, George T. Wohl, and Ralph M. Myerson (Veterans Administration Hospital, Philadelphia). Am. J. Roentgenol., Radium Therapy Nuclear Med. 85, 119-22(1961) Jan.

Cholografin labeled with I^{131} injected intravenously into 37 normal and cirrhotic subjects gave urinary excretions differing significantly between both groups, both in total excretion and in rate of excretion. With few exceptions cirrhotics excreted a larger percentage of the contrast material in 24 hr and at a more rapid rate than normals. The total excretion and rate of excretion mirrored each other in all cases. Study of the urinary excretion of radioactive cholografin at the end of 48 and 72 hr yielded no information additional to that already obtained. There was detectable radioactivity over the thyroid gland in all patients so studied. Counting of blood samples and external counting over the liver failed to differentiate between the two groups. (auth)

7174 DISTRIBUTION OF BROMIDE IN MICE. AN AUTORADIOGRAPHIC STUDY WITH Br^{82}. Rune Söremark and Sven Ullberg (Royal Dental School, Stockholm and Royal Veterinary Coll., Stockholm). Intern. J. Appl. Radiation and Isotopes 8, 192-7(1960) Oct. (In English)

The distribution of Br^{82} in entire mouse cadavers was studied autoradiographically at various intervals after intravenous injection. The concentration of Br^{82} in the organs of fully developed foetuses was compared with that in their dams. Bromine-82 levels in various tissues were determined quantitatively on autoradiograms and histological sections. Tissue levels are expressed as percentages of the blood level. The results are compared with those obtained for other halogens. Special attention is given the stomach, central nervous system, salivary glands, and thyroid glands. Among other clinical and experimental appli-

cations of Br^{82}, measurement of the extracellular space and studies of gastric secretion are discussed. (auth)

7175 EARLY INCORPORATION OF SULPHUR-35 SODIUM SULPHATE INTO PLASMA PROTEINS OF MAN. Bernard A. Sachs, Edward Siegel, and Joseph V. Marino (Montefiore Hospital, New York). Nature 188, 1125-7 (1960) Dec. 24.

Measurements were made of the incorporation of S^{35} in human plasma protein fractions. Mechanisms by which S^{35} is bound to protein are discussed. The rapidity with which inorganic sulfate was incorporated into plasma protein suggests that an alternative metabolic pathway may exist. (C.H.)

7176 A SEXUAL DIFFERENCE IN THE CONCENTRATION OF IODINE-131 BY THE SUBMAXILLARY GLAND OF MICE. J. L. Llach, J. H. Tramezzani, and J. R. Cordero Funes (Instituto de Biología y Medicina Experimental, Buenos Aires). Nature 188, 1204-5(1960) Dec. 31.

Findings are reported on the sexual difference in the iodine-concentrating capacity of submaxillary glands of mice. Sixty-one male and forty female C3H mice were injected intraperitoneally with 5 μc of carrier-free solution of I^{131}. One hour later the submaxillary gland was removed and blood collected under ether anesthesia. The glands and blood were weighed and radioactivity measured in a well counter. The results are tabulated. These results show that there is a sexual difference in the capacity to concentrate iodine by the submaxillary gland of mice. (auth)

7177 UPTAKE OF CALCIUM BY EXCISED BARLEY ROOTS. David P. Moore, Louis Jacobson, and Roy Overstreet (Univ. of California Coll. of Agriculture, Berkeley). Plant Physiol. 36, 53-7(1961) Jan.

The uptake of calcium by 6-day-old excised barley roots appears to be largely nonmetabolic. The calcium uptake at pH 5 was found to be insensitive to low temperature and dinitrophenol. The uptake of Ca^{45} was a reflection of isotopic exchange for initially present inert calcium in the root. This equilibration process was not affected by dinitrophenol. There was a large uptake of calcium by this material at pH 11. This uptake was also largely nonmetabolic. Only a small fraction of the calcium uptake at high pH could be accounted for by an increase in organic acids or by precipitation as $CaCO_3$. It is postulated that much of the calcium in young barley roots is associated with the cell surface region. It is proposed that the calcium which is active in influencing the absorption of other ions is localized on this surface. (auth)

7178 INFLUENCE OF CALCIUM ON SELECTIVITY OF ION ABSORPTION PROCESS. Louis Jacobson, Raymond J. Hannapel, David P. Moore, and Michail Schaedle (Univ. of California, Berkeley). Plant Physiol. 36, 58-61(1961) Jan.

Several polyvalent cations affect absorption by excised plant roots similarly to calcium. Magnesium appears to be an exception. It is suggested that either the particular mechanism involved is not specific for calcium or that the polyvalent cations act via a calcium interaction. Calcium was found to have the property of drastically altering the ratio of absorption of sodium and potassium from a mixture of the two. Using lithium and Na + K solutions it was shown that the absorption system was extremely sensitive to small concentrations of calcium. As little as 10^{-6} M calcium was sufficient to cause a detectable change in absorption rates. The effect of calcium is enhanced in mixtures of sodium and potassium compared to its effect in single salt solutions. The essentially constant sum of the absorptions of sodium and potassium in spite of large changes in the ratio of absorbed sodium and potassium caused by the presence of calcium suggests a common metabolic carrier. The controlling behavior of calcium was found in the roots of six different species of plants. This may indicate a widespread occurrence. (auth)

7179 EFFECT OF ROOT TO SOLUTION RATIO IN ION ABSORPTION EXPERIMENTS. Louis Jacobson, Raymond J. Hannapel, Michail Schaedle, and David P. Moore (Univ. of California, Berkeley). Plant Physiol. 36, 62-5 (1961) Jan.

Large differences in absorption behavior are caused by changing the root to solution ratio in absorption experiments. Aeration ordinarily is not a factor. Changes in pH as a result of absorption activity cause a reduction in absorption rates. This factor may be eliminated by appropriate control measures. The liberation of calcium and other absorption modifying substances from the roots is the most important factor. Much of the effect of increased root to solution ratios on absorption can be accounted for by calcium liberation. The composition and concentration of the absorbing solution are important in determining the amount of calcium released from the roots. The fact that ion absorption is subject to such influences raises the question of the validity of certain types of kinetic studies and in general complicates the interpretation of all quantitative absorption data. (auth)

7180 EFFECT OF VARIOUS CATIONS UPON ABSORPTION OF CARRIER-FREE CESIUM. Raymond Handley and Roy Overstreet (Univ. of California, Berkeley). Plant Physiol. 36, 66-9(1961) Jan.

The effects of the monovalent cations K, Na, NH_4, Rb, Li, and Cs and of the divalent cations Ca, Mg, and Ba upon the absorption of carrier-free Cs^{137} by excised barley roots have been investigated. In the concentration range of 0 to 0.10 meq per liter Na, Li, Ca, Ba, and Mg had essentially no depressant effect upon Cs^{137} uptake whereas K, Rb, NH_4, and Cs were markedly effective. At higher concentrations all ions investigated inhibited the absorption of Cs^{137}. The uptake of carrier-free Cs^{137} was found to be strongly temperature dependent and is therefore largely the result of metabolic absorption rather than of diffusion and adsorption phenomena. In spite of this the behavior of the ions studied in inhibiting uptake of Cs^{137} parallels their behavior in respect to competition for exchange sites upon soil colloids. A possible reason for this is discussed. (auth)

7181 CYANIDE AND CHELATING AGENT EFFECTS ON IN VITRO CO_2 FIXATION IN SWEET ORANGE LEAVES. A. Wallace and R. T. Mueller (Univ. of California, Los Angeles). Plant Physiol. 36, 118-20(1961) Jan.

Cyanide, azide, and chelating agent effects on in vitro dark $C^{14}O_2$ fixation studies with R5P and PEP as substrates with preparations from sweet orange leaves were compared. Cyanide increased the fixation when added with the PEP during the incubation period. When added just before the acid that was used to stop reactions and expel unreacted bicarbonate, cyanide resulted in increased C^{14} counts on planchets for both substrates but the effect was much less than when present during the incubation. The major effect of cyanide appeared to be in stabilization of OAA by formation of a cyanohydrin. The OAA cyanohydrin was identified when the PEP substrate was used. Removing heavy metals did not alter the increased fixation resulting from cyanide. Cyanide overcame inhibitory effects of heavy metals when the latter were added to the PEP reaction system except for zinc. In general the metal effects were on the reactions themselves rather than on metal-induced de-

carboxylation of products. The stimulating effect of a chelating agent was additive with either cyanide or azide and occurred in a system cleaned of heavy metals by ammonium sulfate precipitation with EDTA and dialysis. (auth)

7182 SELECTIVE PLACENTAL TRANSMISSION OF RADIOACTIVE ALKALINE EARTHS AND PLUTONIUM. Paul N. Wilkinson and Frank E. Hoecker (Univ. of Kansas, Lawrence). Trans. Kansas Acad. Sci. 56, 341-63(1953).

A series of experiments is described in which the placental transmission of several of the alkaline earth metals and plutonium is investigated in rats. Results are presented which demonstrate the existence of significant differences in the physiological activity of these elements. The arrangement of these compounds in order of the magnitude of transmission is $Ca^{45} > Ba^{140} > Pu^{239} > Ra^{226}$. A discussion of the possible significance of these results and the results obtained by other workers is presented. It is concluded that the placental transmission of the compound investigated is dependent upon the molecular weight of the cation and that analogies between the known properties of one member of the group and those of another member should be made with extreme caution. The results are indicative of a fundamental difference in metabolic handling of these substances by the animal organism and that similar differences might exist in the mechanism of deposition of these elements in mammalian bone. (auth)

7183 RADIOACTIVE ISOTOPES IN BIOCHEMISTRY. Engelbert Broda. New York, Elsevier Publishing Co. 1960. 386p.

An introduction to the methodology of biochemical research using labeled atoms is presented with selected examples of how radioactive tracers can solve biochemical problems; questions of radiation effects or medical aspects are not considered in detail. The chapters cover: a historical survey, radioisotope activity and purity, radiochemistry principles, radiosynthesis, isotope effects, radiation chemistry and biology, radiation protection, measurement of radioactivity, analysis of living matter with radioisotopes, absorption and excretion of elements, and intermediary metabolism (phosphorylations, photosynthesis, carbohydrates, fats, proteins, and nucleic acids). (D.L.C.)

Fallout and Ecology

7184 (TID-11407) MECHANISMS OF UPTAKE OF IONS BY ABOVE GROUND PLANT PARTS AND THEIR SUBSEQUENT TRANSPORT AND REDISTRIBUTION WITHIN THE PLANT. Technical Progress Report. ([Michigan State Univ., East Lansing]). 1960. 8p. Contract AT(11-1)-888. OTS.

Progress is reported on tracer studies of mechanisms involved in the uptake of ions by above-ground plant parts and their subsequent transport and redistribution. Data are included on factors affecting the foliar absorption of Sr^{89} and Sr^{90}; the distribution of Sr^{90}; the transport of P^{32}, Ca^{45}, and Zn^{65} from bean cotyledons to the remainder of the embryo during germination; and the effect of electrical stimulation on absorption and transport of Ca^{45}. (C.H.)

7185 NATURAL RADIOACTIVITY AND THE EFFLUENTS AT SACLAY. Jean Debiesse (Centre d'Études Nucléaires, Saclay, France). Bull. inform. A.T.E.N., No. 25, 1-7(1960) Sept.-Oct. (In French)

A discussion of the contribution of Saclay nuclear operations to natural radioactivity is given. It is shown that a man annually absorbs from air, water, and soil about 70 mrem externally and 30 mrem from internal origin. This corresponds to 5 to 7 rem per lifetime. In some regions this can be 10 to 20 times higher. The types and amounts of radioactivity released to the environment by six reactors, six accelerators, and numerous laboratories are presented. It is concluded that Saclay's gaseous effluents are harmless. Liquid effluents contribute less than that naturally transported in the rivers. Marcoule contributions as Sr^{90}, Ra^{228}, Cs^{137}, and K^{40} are listed. (T.R.H.)

7186 DISTRIBUTION STUDIES OF RADIOACTIVE FLUORINE-18 AND STABLE FLUORINE-19 IN TOMATO PLANTS. Myron C. Ledbetter, Radu Mavrodineanu, and Allen J. Weiss (Brookhaven National Lab.). Contribs. Boyce Thompson Inst. 20, 331-48(1960) Jan.-Mar. (BNL-4721)

A study of distribution and site of accumulation of fluorine in tomato plants was carried out using NaF^{18}, HF^{18}, NaF^{19}, and HF^{19} applied as solutions through roots and cut vascular systems, and in gaseous form to the aerial parts. In order of decreasing concentration, the gross distribution of fluorine applied as NaF^{19} through the soil was: roots, lower leaves, upper leaves, and stems. Regardless of the path of entrance of the fluorine into the plant, it was possible to wash up to 68 per cent of the fluorine from the leaves with distilled water and up to 83 per cent with water containing a detergent (Tween #20). Distribution based on autoradiograms showed that most accumulation of F^{18} applied as HF^{18} to tomato plants was at the tips and margins of leaflets and in the glands along the stem. Little F^{18} was found in the stems and petioles. In short-term or long-term experiments up to 80 per cent of the F^{18} or F^{19} of the leaves applied as HF was found in the stripped epidermis of Sedum spectabile Boreau. Distribution of F^{19} applied as HF^{19} to tomato leaves after long-term accumulation was, in order of decreasing concentration: cell walls, chloroplasts, soluble proteins, mitochondria, and microsomes. With short-term accumulation of F^{18} applied as HF^{18} the order was: soluble proteins, chloroplasts, cell walls, and mitochondria. The fluorine in the chloroplasts was associated mainly with the proteinaceous substances since little or no F^{19} was found in the pigments and lipids. (auth)

7187 RADIOACTIVITY IN WOOL. Roman Kulwich, Louis Feinstein, Robert W. Decker, Calvin Golumbic, Mary E. Hourihan, and C. E. Terrill (Department of Agriculture, Beltsville, Md.). Nature 188, 511(1960) Nov. 5.

A low-level γ-ray detector employing plastic scintillators was used to measure the γ-ray activity emitted by raw and scoured wool. The scoured wool samples emitted a lower quantity of γ-ray activity than did the grease wool samples. The major impurities in grease wool are grease, suint, and dirt. The suint or dried perspiration is high in potassium content. Since all potassium in nature contains essentially a constant proportion of the γ-ray emitter, 1.46-Mev K^{40}, it is probable that measurements reflect the presence of suint in the grease wool samples. (B.O.G.)

7188 CHANGES WITH TIME IN THE AVAILABILITY OF STRONTIUM-90 IN SOIL. Helen M. Squire (Agricultural Research Council Field Station, Compton, Berks, Eng. and Agricultural Research Council Radiobiological Lab., Letcombe, Berks, Eng.). Nature 188, 518-19(1960) Nov. 5.

The experiment was designed to investigate both the rate at which Sr^{90} moves down the soil profile under natural conditions and the manner in which the absorption of Sr^{90} by plants changes with time, either as a result of penetration in the soil or because of chemical changes over long

periods. The ratio of Sr^{90} to calcium in the grass grown on all soils decreased by ~20 to 30% for the four growing seasons. The availability of Sr^{90} which had been incorporated in the soils for 3½ years was compared with that of Sr^{89} which was freshly added to the soil. Tabulated results show that the amount of freshly added Sr^{89} which became equilibrated with the calcium chloride solution ranged from 26.5 to 55.5% in soil samples. The corresponding values for Sr^{90} were some 3 to 10% lower. This difference was significant for most soil samples. (B.O.G.)

7189 RADIOCAESIUM IN HUMAN BEINGS. J. Rundo (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Nature 188, 703-6(1960) Nov. 26

A re-examination was made of measurements of Cs^{137} in human beings. Conclusions are given concerning the trend of the levels to the end of June 1960. In comparing the levels from subject to subject, the ratio of the Cs^{137} content to the potassium content was used to minimize the effects of variations in the sizes of the subjects and their potassium content, and the cesium content is related to the mass of the muscle, its main site of deposition. The ratios are tabulated in $\mu\mu c$ of Cs^{137} per gram of potassium. The data show that not only is the trend reported for Chicago substantially the same as that found in Britain, but the mean values are practically identical. It is concluded that the intake is from world-wide fall-out from nuclear test explosions, rather than from local contamination by a nuclear installation. (B.O.G.)

7190 WORLD-WIDE DISTRIBUTION OF IODINE-131 IN ANIMAL THYROIDS FOLLOWING ANNOUNCEMENTS OF ISOLATED NUCLEAR WEAPONS TESTS IN NORTH AFRICA. L. Van Middlesworth (Univ. of Tennessee, Memphis). Nature 188, 748-9(1960) Nov. 26.

Preserved thyroid glands from cattle, sheep, and swine were analyzed for I^{131} content following the announcement of isolated nuclear weapons tests in the Sahara Desert. The γ radioactivity was measured and corrected to the date of slaughter of the animals. The thyroid glands were received from Australia, China, England, Germany, Israel, Japan, Portugal, and from Tennessee and Washington in the United States. The results are given for $\mu\mu c$ of I^{131} per gram of thyroid for slaughter dates from January to July 1960 showing the relation of the test dates to the I^{131} content in the glands. These investigations show that the monitoring of radioiodine in thyroid glands of grazing animals is a sensitive and informative method for evaluating the biological exposure of animal populations to fission products. (B.O.G.)

7191 IN VITRO UPTAKE OF IODINE-131 BY TISSUES OF RAINBOW TROUT. M. Maqsood, E. P. Reineke, and P. O. Fromm (Michigan State Univ., East Lansing). Nature 188, 1030-1(1960) Dec. 17.

The values of the ratio T/M for in vitro uptake of I^{131} by different tissues of rainbow trout indicated that only thyroid follicles present in the lower jaw concentrated I^{131}. The T/M value was higher in the case of the posterior part of the lower jaw than the anterior part, indicating that the thyroid follicles are comparatively more numerous in the posterior part. Uptake of I^{131} was higher in the lower part of the gill than the upper part. Addition of thiouracil (0.02 mgm/ml) to the medium did not affect uptake, whereas potassium thiocyanate blocked such uptake by thyroid follicles. The T/M values for uptake of I^{131} by different organs of the digestive system, kidney, head kidney, liver, spleen, heart muscle, skeletal muscle, or brain were less than 1.0. (D.E.B.)

7192 UPTAKE OF MAGNESIUM-28 BY THE SKELETON OF A SHEEP. Alexander C. Field (Moredun Inst., Gilmerton, Edinburgh). Nature 188, 1205(1960) Dec. 31.

After six days on a constant diet of grass nuts containing 1.2 g of magnesium, a five-year-old Greyface wether, weighing about 65 kg, was given 40 to 60 μc carrier-free Mg^{28} as the chloride into the jugular vein. Ten hours later, immediately after sampling the blood, the sheep was killed by exsanguination under nembutal anesthesia, and duplicate samples of bone, free so far as possible from blood and bone marrow, were taken from various parts of the skeleton and their radioactivity determined the same day in a well type scintillation counter. Data are tabulated. (auth)

7193 THE Sr^{90} CONCENTRATION IN HUMAN BONES IN THE YEARS 1958 AND 1959. D. Merten and O. Pribilla (Bundesforschungsanstalt für Milchwirtschaft, Kiel, and Univ., Kiel). Naturwissenschaften 47, 503(1960) Nov. (1). (In German)

The Sr^{90} concentration was determined in 91 bone samples. The mean values of the results are graphed according to the age group and the year. It is shown that an increase in the Sr^{90} contamination is found, especially in the age group from 0 to 5 years. (J.S.R.)

7194 ZINC-65 AND CHROMIUM-51 IN FOODS AND PEOPLE. R. W. Perkins, J. M. Nielsen, W. C. Roesch, and R. C. McCall (General Electric Co., Richland, Wash.). Science 132, 1895-7(1960) Dec. 23. (HW-SA-1928)

Some radioisotopes introduced into the Columbia River via effluent water from reactors at Hanford, Wash., are found in crops irrigated with this water and in sea food harvested near the mouth of the river. Measurements of Zn^{65} and Cr^{51} in foods and in individuals consuming these foods are reported and compared with Zn^{65} concentrations resulting from fall-out. (auth)

7195 ON THE SOIL CHEMISTRY OF RADIO-IODINE. Manzoor E. Raja and K. L. Babcock (Univ. of California, Berkeley). Soil Sci. 91, 1-5(1961) Jan.

The behavior of carrier-free I^{131} in two Californian soils in two clay minerals, and in peat has been studied. The results of pretreatment by autoclaving, oxidation with peroxide, and digestion with alcohol, as well as extraction of I^{131} with various salt solutions, all indicate that the large fraction of I^{131} retained by the soils are due to reaction with organic matter. (auth)

Radiation Effects on Living Tissues

7196 (ORO-344) PHYSICAL AND RADIOBIOLOGICAL INVESTIGATIONS WITH 22-Mevp X-RAYS AND ELECTRONS AS COMPARED WITH COBALT-60 γ-RAYS AND 200-kvp X-RAYS. Final Progress Report [for] Period [Covered] May 1, 1960–August 31, 1960. R. J. Shalek (Texas. Univ., Houston. M. D. Anderson Hospital and Tumor Inst.). 6p. Contract AT(40-1)-2028.

Using a variety of biological materials and end points, it was found that the radiation dose of 200-kvp x rays required to produce a given observable effect is about 0.90 the dose of Co^{60} γ rays or 22 Mevp x rays required to produce the same effect. The γ rays and 22 Mevp x rays were found to be equally effective. The biological end points used included the mean lethal dose for mice, rats, yeast, and chick embryo; depression of Fe^{59} uptake of the erythrocytes of rats; and chromosome damage in mouse ascites tumor cells. Progress is reported in studies of reaction mechanisms involved in the explanation of rela-

tive biological effects and problems related to radiation dosimetry. (C.H.)

7197 (UR-565) GENETIC EFFECTS OF CHRONIC X-IRRADIATION EXPOSURE IN MICE. Donald R. Charles, Joseph A. Tihen, Eileen M. Otis, and Arnold B. Grobman (Rochester, N. Y. Univ. Atomic Energy Project and Florida. Univ., Gainesville. Florida State Museum). Sept. 1958. 364p. Contracts W-7401-eng-49 and AT(40-1)-2136.

Groups of male dba mice were exposed daily for adult life time to x irradiation as follows: 58 at 0.1 r/day; 29 at 0.5 r/day; 16 at 1.0 r/day and 33 at 10.0 r/day. A control group of 51 was similarly maintained. These animals were bred and their immediate offspring numbering over 12,000 were examined for genetic changes. It is concluded that the incidence of mortality, rare morphological anomalies, visible tested mutations, and litter size mutations taken together are definitely increased by radiation at the rate of at least 1.16×10^{-4} per r-unit of paternal exposure. There is no evidence that the effect per roentgen is less at the lower rates of exposure. The experimental methods and the data are presented in detail. No attempt was made to evaluate recessive mutation. (auth)

7198 (USNRDL-TR-489) LIVER CELL PROLIFERATION IN X-IRRADIATED RATS AFTER SINGLE AND REPETITIVE PARTIAL HEPATECTOMY. G. F. Leong, R. L. Pessotti, and J. S. Krebs (Naval Radiological Defense Lab., San Francisco). Dec. 20, 1960. 25p.

It has been shown previously that following exposure to x radiation, abnormal mitoses occur in regenerating liver. The behavior of this system in the rat under repeated stimuli to proliferation has been studied to determine the regenerative behavior of such a tissue containing cells with demonstrably damaged nuclear-mitotic apparatus. Irradiation involved two 400 r exposures three weeks apart. Successive partial hepatectomies were performed 8 weeks, 11 weeks, and 14 weeks after the last exposure. Liver weights recovered to within 15 to 20% of controls after the first, as well as after subsequent partial hepatectomies. Radiation exposure does not affect liver weight to body weight ratios under those conditions. By contrast, mitotic index in the irradiated rats is consistently 50 to 60% below values in nonirradiated controls. Less than 10% of the mitoses in regenerating liver of nonirradiated rats were visibly aberrant, whereas 75 to 85% of the mitoses in all post-radiation animals were abnormal. The discrepancy between mass regeneration and mitotic frequency, and the effect of a very high proportion of cells with damaged mitotic-nuclear apparatus on growth potential are discussed. (auth)

7199 (AEC-tr-4401) LETHAL AFTEREFFECTS AFTER INCORPORATION OF P^{32} IN AMOEBA PROTEUS AND THEIR INTERPRETATION BY GENETIC SUBUNITS. H. Friedrich-Freksa and F. Kaudewitz. Translated for (Oak Ridge National Lab.) from Z. Naturforsch. 8b, 343-55 (1953). 43p. (Includes original, 9p.).

The lethal consequences of the incorporation of P^{32} were studied in a clone of Amoeba proteus grown under constant conditions. It was possible to label the individual cells without impairing motility, absorption of nutrition, and dividing capacity. Progeny of these cells were observed for 100 consecutive cell generations. The percentage of lethalities induced by P^{32} was calculated. A comparison of the results of the experiments and controls showed that the absorption of radioactive phosphorus by amoeba cells results in an increase of lethality in subsequent generations. (C.H.)

7200 CATARACT AS A LATE SEQUEL OF CONTACT ROENTGEN THERAPY OF ANGIOMAS IN CHILDREN. V. Bek and K. Zahn (Roentgen Clinic and Eye Clinic, [Prague] and Charles Univ., Prague). Acta Radiol. 54, 443-8(1960) Dec. (In English)

Control examination of a group of 51 children, who had been subjected 4 to 14 years previously to contact roentgen therapy for angiomas of or near the eyelids, revealed radiation cataracts in two of the subjects. The probable causes of the sequelae are explained and attention is drawn to the precautions that are necessary in the treatment of this condition. (auth)

7201 THE USE OF X RAYS TO INDUCE SOMATIC MUTATIONS IN SAINTPAULIA. Arnold H. Sparrow, Rhoda C. Sparrow, and Lloyd A. Schairer (Brookhaven National Lab., N. Y.). African Violet Mag. 13, 32-7(1960) June. (BNL-4667)

A method of obtaining mutant plants from x ray treatment of petioles of a diploid variety of African violet (Saintpaulia ionantha) is described. Vegetative propagation of new plants from petioles given 2000 r and 3000 r gave a 10.06 and 21.38 per cent increase in mutant plants above the average value observed in controls of the same variety. Many different mutant types were produced, some of which may have sufficient merit to become successful named varieties. In addition to some desirable mutants a large group were clearly inferior in growth rate and in ornamental value. Some of the desirable mutants may represent types not previously known in named American African violet varieties. Additional recessive mutations could probably be recovered by selfing and seed propagation of the plants grown from irradiated petioles. This has not yet been done. The technique of inducing mutations with ionizing radiation offers an alternate method to standard hybridization for obtaining additional genetic variability. Once a desirable characteristic has been induced this can be propagated and reirradiated. Mutant characters can thus be added stepwise. Useful ones are kept and the undesirable ones discarded. Present indications are that almost all the induced mutant plants grown from irradiated petioles of African violets are nonchimeric with the result that the mutant characters almost always persist through repeated vegetative propagations. The high percentage of nonchimeric plants is presumably due to the fact that a new plantlet (or shoot) can originate from a single epidermal cell. A special application of the method would be to induce further desirable changes in sterile forms where standard breeding methods cannot be used readily. (auth)

7202 THE EFFECTS OF ROENTGEN IRRADIATION ON ADRENAL CORTICAL FUNCTION IN MAN. Ward A. Soanes, Robert S. Cox, Jr., and John R. Maher (Letterman Army Hospital, San Francisco and Sixth U. S. Army Medical Lab., Fort Baker, Calif.). Am. J. Roentgenol., Radium Therapy Nuclear Med. 85, 133-44(1961) Jan.

Nine cases of patients with testicular tumors receiving therapeutic doses of roentgen rays to the region of the adrenal glands are presented. The 17-ketosteroid and 17-hydroxycorticosteroid excretion studies were carried out prior to the initiation of radiation therapy, during therapy, and for a follow-up period. Adrenal steroidogenesis was evaluated by the response of the adrenal to stimulation with 40 units of ACTH administered intravenously over a 10-hr period on one day, or on two successive days. The data indicate a variable degree of enhancement of adrenal cortical steroidogenesis during or immediately

following radiation therapy to the adrenal glands in the majority of patients, presumably reflecting the general adaptation syndrome to stress. Most patients acquired a mild degree of adrenal cortical impairment secondary to such irradiation. The data indicate that the administration of more than 2000 r tissue dose to the adrenal glands produces increased adrenal cortical steroidogenesis during irradiation in response to the one-day intravenous ACTH stimulation test. Less than 2000 r tissue dose produces no impairment or stimulation of adrenal steroidogenesis or reserve as measured by one- or two-day intravenous ACTH stimulation. Administration of 2000 to 3000 r tissue dose produces a transient stimulation with a simultaneous loss of adrenal cortical reserve as shown by intravenous ACTH administration on two consecutive days. More than 3000 r tissue dose results in transient stimulation followed by subsequent adrenocortical impairment as manifested by stimulation by one day of intravenous ACTH administration. Following 3500 r tumor dose, the adrenal glands still appear to have a normal amount of steroidogenesis under nonstress conditions, but their ability to respond to stress is markedly limited. The data on patients receiving roentgen radiation through portals including the adrenal glands and through other portals suggest that the enhancement and impairment observed are both due to direct irradiation of the adrenal glands, but generalized secondary systemic toxicity may play a role. One patient who died showed no evidence of functional adrenal cortical impairment after 3500 r tumor dose to the adrenal glands and 3000 r tumor dose to the mediastinum. At autopsy, no histologic changes of the adrenal cortex were found. Study of the adrenal glands of other patients receiving similar doses of therapeutic roentgen radiation to the adrenal glands likewise failed to reveal any characteristic or significant histologic changes. (auth)

7203 SENSITIZATION AND RECOVERY PHENOMENA AFTER EMBRYONIC IRRADIATION. Melvin R. Sikov and James E. Lofstrom (Wayne State Univ., Detroit and Receiving Hospital, Detroit). Am. J. Roentgenol., Radium Therapy Nuclear Med. 85, 145-51(1961) Jan.

Pregnant female rats were subjected to a preliminary exposure of roentgen rays at six days of gestation and again irradiated with a variety of doses at nine days. The results of such exposure, expressed in terms of embryonic mortality, growth, and abnormalities, were compared to the damage produced by a single exposure at either six or nine days. It was found that a 110-r preliminary exposure dose reduced the LD_{50}, determined as the dose required to kill 50% of the embryos by 14 days of gestation, from 147 to only 115 r. Pretreatment at six days with a second exposure at nine days also served to eliminate the threshold usually seen with single exposures from the dose-response curve. Similar results were obtained when weight depression was studied. The dose of radiation at nine days of gestation required to obtain mandibular shortening in 50% of the fetuses was markedly decreased by a previous exposure at six days. This treatment also significantly decreased the dose required to obtain eye changes. Pretreatment was not effective in increasing the incidence of maxillary changes. The data obtained in these experiments were interpreted as indicating that a sensitization of the embryo occurs, which enhances the teratogenic effects of later radiation exposures. It was also found that recovery from certain of such effects may occur and at a rate greater than that found in the adult rat. These findings may be shown to have ultimate clinical importance. (auth)

7204 ROENTGEN REGRESSION IN AXOLOTL (SIREDON MEXICANUM). V. V. Brunst (Roswell Park Memorial Inst., Buffalo). Am. J. Roentgenol., Radium Therapy Nuclear Med. 85, 158-78(1961) Jan.

Reduction was observed in 90% of the regenerated limbs of adult axolotls irradiated with 4000 r, and in 100% of those irradiated with 6000 r. Reduction begins in the distal end and progresses proximally. The skin epithelium is gradually reduced in area without the formation of open wounds. Histologic investigation showed that the conditions of the skin epithelium depended upon the interval between irradiation and fixation. In most cases, early fixation revealed epithelial damage, i.e., formation of giant cell degenerating epithelium, while late fixation revealed normal epithelium. The condition of the epithelium is the result of a specific reaction of this tissue and is independent of the reduction of the limb in general. The mechanism of the epithelium reduction is obscure, but it is independent of macrophage activity. A hypothetical explanation is given. Damage of the subcutaneous pigment layer or separate pigment cells was observed in all cases, but the condition of these cells varied greatly in different areas of the limb. Resorption of the cartilaginous and bony skeleton is a result of macrophage activity. The attack of macrophages on the skeletal elements always begins at the surface. Bone and cartilage are dissolved as a result of the action of lytic enzymes secreted by macrophages which are located near the skeletal surface. Comparatively small macrophages penetrate deeply into the cartilaginous substance and dissolve the cartilage, forming many empty spaces in various areas. Such spaces are never observed in normal cartilage. During advanced reduction all distal capillaries and small blood vessels disappear and in many cases the large blood vessels in the distal regions are transformed into peripheral sinuses. Resorption occurs in the presence of abnormal blood supply. The loose connective tissue has an important role in the distribution and spread of macrophages. Through this tissue the macrophages can penetrate into the bone, cartilage, and other tissues. During the resorption, the amount of connective tissue is decreased greatly, probably as a result of macrophage activity. During reduction, compact muscle bundles are reduced to isolated small thin bundles or even isolated irregularly oriented fibrils and isolated nuclei. Macrophages are found between them. Resorption of muscles is a result of macrophage activity. Resorption of teeth of young and adult axolotls, once it has begun, is completed quickly within 10 to 15 days and is the result of macrophage activity. Resorption of the lens of the young axolotl after irradiation of the head is the result of macrophage activity. Regression, reduction, or resorption is the result of reaction of the nonirradiated body to the irradiated portion, and is the direct result of macrophage activity. Resorption is a specific reaction of amphibians and is observed during normal development at the time of metamorphosis. Resorption can be provoked by roentgen rays or other factors. This response is related to the ability of these animals to undergo transformation during metamorphosis. (auth)

7205 THE RESPONSE OF SWINE AFTER EXPOSURE TO THE GAMMA-NEUTRON FLUX OF A NUCLEAR DETONATION. Kent T. Woodward, Gerald M. McDonnel, Payne S. Harris, Willie J. Kirkland, and James N. Shively (Walter Reed Army Inst. of Research, Washington, D. C.). Am. J. Roentgenol., Radium Therapy Nuclear Med. 85, 179-85(1961) Jan.

The responsiveness of 264 swine exposed to doses from 410 to 2475 rads of γ-neutron radiation from a nuclear detonation is described. The LD_{50} value at 30 days was 486 (478 to 496) rads. Median survival times for swine were similar to those of other mammalian species. The potency

of fission neutrons as compared to γ rays from a nuclear detonation was estimated to be about 1.2 for the production of lethality at 30 days in swine. (auth)

7206 MERISTEM INITIAL CELLS IN IRRADIATED ROOTS OF VICIA FABA. D. Davidson (Oak Ridge National Lab., Tenn.). Ann. Botany (London) 24, 287-95(1960) July.

Beans (Vicia faba) were germinated for 24 hr and irradiated with x rays. Primary roots were fixed after 9, 11, and 21 days. Aberrant chromosome complements, the result of chromosome changes induced by irradiation, were present. They were used as cell markers to estimate the number of cell types present in the meristem initial cells of the growing root and the number of primordium initial cells from which root regeneration occurred. Up to 9 cell types occur as meristem initials. From the relative frequencies of the different cell types, it is estimated that there are at least 32 actual meristem initial cells in regenerating irradiated primary roots. This result is compatible with observations made on normal roots. The chimaerical nature of the regenerating root apparently does not interfere with the normal organization of the meristem, but it serves to reveal what part of the organization is. (auth)

7207 THE EFFECT OF ENDOCRINE CHANGES, OF IRRADIATION AND OF ADDITIONAL TREATMENT OF THE SKIN ON THE INDUCTION OF TUMOURS IN THE FEMALE GENITAL TRACT OF RATS BY CHEMICAL CARCINOGENS. Cora P. Cherry and A. Glucksmann (Strangeways Research Lab., Cambridge, Eng.). Brit. J. Cancer 14, 489-501(1960) Sept.

Ovariectomy reduced the incidence of vaginal tumors after intravaginal application of 9,10-dimethyl-1,2-benzanthracene (DMBA), and administration of oestrogen or of progesterone raised the incidence of tumors only slightly. Repeated whole-body exposures to x rays also lowered the rate of tumor incidence after painting and so to a lesser extent did repeated pelvic irradiation of virgin rats and the application of DMBA to an additional dorsal skin region. In surgical castrates adrenalectomy or repeated pelvic irradiation restored the level of tumor incidence to that of intact and pregnant rats. Three levels of vaginal tumor incidence were found, and the distribution of tumor types and the length of the average induction time varied with the level: at the lowest level there were only sarcomas, at the intermediate level fibromas and presarcomatous lesions were found in addition to the sarcomas; and at the highest level the incidence of sarcomas is increased and epithelial tumors appear. Tumor induction in the vulva is not affected by castration, radiation, or hormone treatment but varies at certain dose levels with the dose of the carcinogen. (auth)

7208 INDUCTION OF NEOPLASMS IN THE THYROID GLAND OF THE RAT BY X-IRRADIATION OF THE GLAND. S. Lindsay, G. E. Sheline, G. D. Potter, and I. L. Chaikoff (Univ. of California, San Francisco and Berkeley). Cancer Research 21, 9-16(1961) Jan.

The development of benign and malignant neoplasms was studied in thyroid glands of Long-Evans rats 2 years after either both lobes of the glands had been irradiated with 500, 1000, or 2000 r or the right lobe alone had been irradiated with 1000 r. The degree of follicular atrophy and of nuclear pleomorphism observed in these irradiated glands varied with the dose of x rays. Benign nodules or adenomas were observed in 30 of the 74 irradiated rats that survived. These lesions appeared to have originated as foci of nodular regeneration and hyperplasia. Papillary and follicular thyroid carcinomas were found in nine of the irradiated rats. Two of the six papillary carcinomas appeared to have originated in previously benign adenomas. Naturally occurring alveolar or lobular carcinomas had an incidence of 33% in normal control rats and of 22 to 45% in rats whose thyroids were irradiated with x rays. These naturally occurring carcinomas were of low-grade malignancy and were unlike those induced by irradiation. Parathyroid hyperplasia and adenomas were observed frequently in control as well as in irradiated rats. (auth)

7209 THE EFFECT OF GAMMA RADIATION WITH Co^{60} ON THE EXPLANTED CONNECTIVE TISSUE OF THE CHICKEN EMBRYO. A. F. Ivanitskaya and Z. N. Faleeva (Severtsov Inst. of Animal Morphology, Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R. 133, 709-12 (1960) July 21. (In Russian)

Connective tissue from the heart of 7- to 8-day-old chicken embryos was cultured in chicken plasma or embryo extract, and irradiated with a dose of 100 to 200,000 r 24 hr after explantation. The growth, per cent of mitoses and certain cytological characteristics were used to follow the reactions in the tissue cells. It was found that small doses (100 r) showed neither a harmful nor stimulating effect. Doses of 1000 to 5000 r lead to the appearance of pathological forms and a reduction in the number of mitoses immediately after irradiation. However, normal mitotic activity was resumed in the last days of the life of the culture and indicated that reparative processes were going on in the tissue. Doses of 50,000 to 75,000 r cause a complete cessation of mitotic activity in the cell, and the accumulation of large amounts of detritus, but the growth zone continued to increase. Doses of 100,000 to 200,000 r cause degenerative changes in the cells, and a continuous decrease in the number of cells. (TTT)

7210 CHEMICAL PROTECTION OF THE ALIMENTARY TRACT OF WHOLE-BODY X-IRRADIATED MICE. II. CHROMOSOME BREAKS AND MITOTIC ACTIVITY. J. Maisin and J. Moutschen (Oak Ridge National Lab., Tenn.). Exptl. Cell Research 21, 347-52(1960) Nov.

The protective effect of S,2-aminoethylisothiuronium (AET) on mitotic activity and chromosome damage in intestinal crypt cells of x irradiated mice was studied. It was found that the number of chromosome fragments in the crypt cells of both treated and nontreated mice is dose dependent. In lethally x irradiated mice given AET, the number of chromosome fragments was less than that of nontreated mice. At supralethal x ray doses, AET markedly protected mitotic activity. The data indicate that in treated and nontreated mice recovery of mitotic activity was inversely related to the number of chromosome fragments. (auth)

7211 NOTES ON THE RELATIONSHIP BETWEEN THE PROBABILITY OF SURVIVAL OF IRRADIATED RATS AND CARBON DIOXIDE OUTPUT. L. Novák, K. Svoboda, and M. Pospíšil (Inst. of Biophysics, Czechoslovak Academy of Sciences, Brno). Folia Biol. (Prague) 6, 437-40(1960). (In English)

A mathematical analysis of the deviation of initial CO_2 output values from theoretical values was carried out in Wistar rats irradiated with a single whole body dose of 600 r. The maximum deviation from the calculated value occurred in the region of a gross body weight of 268 g. An analysis of the probability of survival of irradiated animals showed the maximum change to be in the region of 265 g body weight. Comparison of the theoretical curves of survival and CO_2 output showed a close correlation between

the two, indicating that there is a close relation between the intensity of metabolism, the weight of the organism, and its radiosensitivity as expressed by the probability of survival. (auth)

7212 EVALUATION OF THE WHOLESOMENESS OF IRRADIATED FOODS. H. F. Kraybill (Public Health Service, Washington, D. C.). Food Irradiation 1, No. 2, A2-A3(1960) Oct.-Dec.

There is no evidence to date that there is any toxicity in irradiated foods for either man or animals. Results of feeding experiments with laboratory animals are reviewed which support this conclusion. (C.H.)

7213 COMMENTS ON THE WHOLESOMENESS OF IRRADIATION-PROCESSED FOODS. B. Connor Johnson (Univ. of Illinois, Urbana). Food Irradiation 1, No. 2, A4-A5(1960) Oct.-Dec.

Results are reviewed from a series of feeding experiments with irradiation-processed foods. It is concluded that irradiation processing does not impair the wholesomeness of foods nor induce toxicity. (C.H.)

7214 HAPLOID INTERSEXES IN THE WASP HABROBRACON. R. C. von Borstel and P. A. Smith (Oak Ridge National Lab., Tenn.). Heredity 15, 29-34(1960) Aug.

During a routine analysis for radiation-induced recessive lethal mutations and translocations, a female was found that produced haploid intersex offspring. These intersexes showed linkage with the orange locus of chromosome 2, as had two previous occurrences of this type of intersex. The intersexes were shown not to have derived from a separation of the sex alleles by a translocation. It is suggested that a gene was mutated that is in some respects analogous to the genes for intersexuality found in different species of Drosophila. The action of Habrobracon would appear to be from male-toward-female rather than the reverse as in Drosophila. (auth)

7215 RADIATION GENETICS IN WHEAT. V. INFLUENCE OF IRRADIATION TIME AND TEMPERATURE ON THE GENETIC EFFECTS OF IONIZING RADIATION IN DIPLOID WHEAT. Seiji Matsumura (National Institute of Genetics, Misima). Idengaku Zasshi 35, 197-204(1960) July. (In English)

Dormant seeds of Triticum monococcum flavescens were exposed to x and γ rays at the dosage of 10 and 20 kr. Growth of seedlings, single spike fertility, and chromosome aberrations of X_1 plant and gene mutations in X_2 were compared for acute and chronic irradiation. At acute irradiation with x and γ rays, treatment was given either immediately before sowing or the irradiated seeds were kept for 30 days in storage at room temperature (about 20°C) or at 5°C. Also, the effect of β radiation by P^{32} was examined for comparison. The relation between the inhibition of seedling growth and dosage, temperature in storage and irradiation time coincides roughly with the relation between the percentage of induced sterility and all those conditions. X and γ irradiations were far more effective at 20 kr than at 10 kr. In the case of 30 day storage, γ rays inhibited the growth of seedlings and reduced the fertility stronger than x rays, whereas irradiation applied just before sowing showed the reverse relation. It was further observed, especially with γ rays, that low temperature had the strongest inhibitory effect. At 10 kr, acute γ irradiation was more effective than the chronic one, whereas at 20 kr the reverse relation was observed. The frequency of chromosome aberrations and gene mutations was strikingly higher at 20 kr than at 10 kr. Irradiation just before sowing and 30 day storage at low temperature were more effective than storage at room temperature after irradiation. The effect of γ irradiation was less. The effects of β irradiation were unexpectedly slight. It was found from another experiment with seed absorption of P^{32} solution that the actual dosage of β rays was very low. (auth)

7216 VARIATION IN THE ATP, ADP AND AMP CONTENT OF THE BRAIN OF X-IRRADIATED RATS. A. Rabassini, C. S. Rossi, and C. Gregolin (Università, Padua, Italy). Ital. J. Biochem. 9, 216-19(1960) July-Aug.

Adenylic nucleotides (ATP, ADP, and AMP) were studied in the brain of x-irradiated rats. Three days after irradiation with a single dose of 1000 r, these nucleotides, especially ATP, were markedly decreased. (auth)

7217 POSTIRRADIATION FRACTURES OF THE FEMORAL NECK. William H. Bickel, Donald S. Childs, and Charles M. Porretta (Mayo Clinic and Mayo Foundation, Rochester, Minn.). J. Am. Med. Assoc. 175, 204-12 (1961) Jan. 21.

The conclusions of a study of 19 patients with 24 postirradiation fractures of the neck of the femur and of the pathological process involved are summarized. With early diagnosis and reasonable care, these fractures will unite in the great majority of instances. We believe that when the fracture is in good position and stable, simple nonweight bearing is sufficient. When the position can be improved, even in late cases, internal fixation after traction is justified. When the fracture is old and greatly displaced, more extensive reconstructive operations must be considered. A vascular necrosis of the head of the femur is an uncommon complication. In one-fourth to one-third of reported cases in which postirradiation fractures of the femoral neck develop, the fractures are bilateral. (auth)

7218 LEAKAGE OF PHOSPHATE COMPOUNDS FROM ULTRAVIOLET-IRRADIATED YEAST CELLS. Paul A. Swenson (Univ. of Mass., Amherst and Brookhaven National Lab., Upton, New York). J. Cellular Comp. Physiol. 56, 77-90(1960) Jan.

A study was made of the action of ultraviolet radiations on the leakage of radioactive phosphate, P^{32}, from uniformly labeled yeast cells. At low dosages leakage is slow and steady for a 24-hr period; at high dosages leakage is rapid and the maximum amount occurs within 4 hr after irradiation. At high dosages 50% of labeled phosphate of the cells is found in the medium after 4 hr. The pH of the medium influences leakage caused by ultraviolet light. Minimum leakage occurs in the region of pH 6. Above pH 8.7 and below pH 2.6 leakage occurs to a considerable extent in nonirradiated cells. Sodium azide and 2,4-dinitrophenol cause increased leakage in irradiated cells, but these poisons do not cause leakage from nonirradiated cells. Leakage from irradiated cells metabolizing glucose is five times that from irradiated cells having no exogenous substrate. The temperature coefficient or Q_{10} for leakage caused by irradiation is 1.5 for the interval 20 to 30°C. A paper chromatographic analysis was made of the leakage products. Positive identification was made of inorganic orthophosphate, 3-phosphoglyceric acid, and adenylic acid. Unique substances appear to be present among the leakage products that are not present in the cells. Leakage is selective. Certain substances that are present in the cell do not leak out following irradiation. The leakage substances resulting from ultraviolet irradiation differ from those resulting from heating the cells at 55°C. Cells rendered nonviable by heating leak a considerable additional amount of phosphate which is chromatographically similar to that from cells irradiated but not heated. The possible causes of leakage of phosphate from irradiated cells are discussed.

The process is not a simple one but the evidence points to membrane damage allowing diffusion of cellular constituents to the exterior as well as to interference with energy-coupled processes in the cell. (auth)

7219 THE RESTORATION OF HEMOLYSIN FORMATION IN X-RAYED RABBITS BY NUCLEIC ACID DERIVATIVES AND ANTAGONISTS OF NUCLEIC ACID SYNTHESIS. William H. Taliaferro and Bernard N. Jaroslow (Univ. of Chicago and Argonne National Lab., Ill.). J. Infectious Diseases 107, 341-50(1960) Nov.-Dec.

The restoration of hemolysin activity was tested in rabbits 24 hr after the administration of 400 r hard x rays at the approximate low point in their hemolysin-producing capacity. The materials tested were injected intravenously either mixed with the antigen or injected separately at the same time except for colchicine and croton oil. The last two materials were given subcutaneously immediately after injecting the antigen intravenously. Among the chemically defined substances tested, colchicine completely restored and 3-indoleacetic acid and kinetin partially restored the hemolysin-producing capacity in irradiated rabbits with respect to peak titer and the rate of rise. In accord with previous work, yeast was also completely restorative. Preparations of DNA and RNA enzymatically degraded in vitro by their specific nucleases were partially restorative, but the two polymerized nucleic acids, adenine, the nucleosides, and the nucleotides were not restorative. Croton oil used as a control for colchicine was without a significant restorative action. Colchicine and, to a lesser extent, yeast increased the hemolysin response in normal nonirradiated rabbits. None of the restorative agents significantly counteracted the lengthened induction period resulting from x radiation. 37 references. (auth)

7220 THE INFLUENCE OF X-RAYS ON THE FORMATION OF CLOSTRIDIUM PERFRINGENS ANTITOXIN IN GUINEA-PIGS. L. G. Kovtunovich (L'vov Inst. of Epidemiology, Microbiology and Hygiene). J. Microbiol., Epidemiol. Immunobiol. (U.S.S.R.) (English Translation 31, 637-43(1960).

Irradiation with x rays 3 to 24 hr before a single injection of adsorbed Cl. perfringens toxoid, caused an appreciable suppression of antitoxin formation, and irradiation administered 3 to 24 hr after the inoculation, caused a slight increase in antitoxin formation. In experiments in which the specific toxoid was injected repeatedly irradiation administered 3 hr before the inoculation did not change the formation of antitoxin, irradiation 24 hr before inoculation somewhat suppressed antitoxin formation, and irradiation administered 3 to 24 hr after the inoculation increased antitoxin formation. Under conditions of late revaccination a stimulation of antitoxin formation could be observed independently of the time and dose of radiation employed. The influence of x rays upon the formation of Cl. perfringens antitoxin in guinea pigs mainly depended on the time of irradiation and on the number of injections of toxoid, and to a lesser degree on the dose of radiation. Although x rays at certain periods suppress antitoxin formation they had no influence upon the immune response of the animal body, and did not impair the response to repeated injection of adsorbed Cl. perfringens toxoid. In our experiments a permanent stimulation of antitoxin formation by x rays in doses of 100 or 500 r, respectively, administered 3 to 24 hr after the first, second, or re-immunizing injection of antigen could be observed, which was apparently due to the fact that massive doses of Cl. perfringens toxoid were used for the immunization which were adsorbed on aluminum phosphate. (auth)

7221 NEOPLASMS AMONG A-BOMB SURVIVORS IN HIROSHIMA: FIRST REPORT OF THE RESEARCH COMMITTEE ON TUMOR STATISTICS, HIROSHIMA CITY MEDICAL ASSOCIATION, HIROSHIMA, JAPAN. Tomin Harada and Morihiro Ishida (National Inst. of Health, Hiroshima). J. Natl. Cancer Inst. 25, 1253-64(1960) Dec.

The 1957 and 1958 incidence of neoplasms among the survivors of the Hiroshima A-bomb varies directly with radiation dose, insofar as it may be inferred from distance from the hypocenter at exposure. The incidence of all malignant neoplasms among the survivors who were within 1000 m is more than four times that of the nonexposed population. The incidence of benign neoplasms among the survivors exposed within 1500 m is also significantly higher than that among the nonexposed. For survivors under 1500 m there are significant differences between the number of observed cancers of the lung, stomach, uterus, and ovary and the expected cases calculated from the age-specific rates of the nonexposed portion of the Hiroshima population. The increased incidence among survivors within 1500 m is not related to sex or age. (auth)

7222 HISTOCHEMICAL STUDIES ON THE INTESTINAL CHANGES INDUCED BY X-RAYS. M. Trasino and E. Gandolfo. Minerva fisioterap. 5, 32-7(1960).

7223 EFFECT OF γ-RADIATION ON NISIN. F. J. Ley (Wantage Research Lab., Berks, Eng.) and R. H. Hall. Nature 188, 1184-5(1960) Dec. 31.

The antibiotic nisin is known to reduce the heat-resistance of spore-forming organisms, and consideration has been given to its use as an additive to lower the heat-process requirements of canned foods. The radiation resistance of spore formers might also be influenced by nisin, and the dose required for the sterilization of food lowered to a level where radiation-induced flavor and odor changes are not detectable. Experiments were conducted to determine the effect of radiation on the antibiotic activity of nisin when it was suspended in a variety of media and at different pH values. Results are tabulated. Data indicated that nisin added to foodstuffs prior to radiation processing will be rendered ineffective against bacterial spores which survive the radiation treatment, especially in the sterilization dose-range of 1 to 3 megarads. There is a possibility, however, that nisin might be protected from radiation damage to some extent in the presence of spores, particularly if it acts by absorption on the spore coat. (auth)

7224 EFFECT OF NITROGEN MUSTARD IN RABBITS FOLLOWING EXPOSURE TO X-IRRADIATION. O'Neill Barrett, Jr. (Walter Reed Army Inst. of Research, Washington, D. C.). Proc. Soc. Exptl. Biol. Med. 105, 445-7(1960) Dec.

Rabbits that had been exposed to whole-body x irradiation showed a significant mortality rate following injection of 1.5-mg/kg body weight nitrogen mustard in contrast to the control group where no deaths occurred. This difference was noted even though bone marrows of the x-irradiated group were functionally normal when nitrogen mustard was administered. (auth)

7225 EFFECTS OF IRRADIATION TO ADRENAL UPON CIRCULATING ADRENAL CORTICAL HORMONE IN THE RAT. M. G. Griffith, J. Q. Griffith, Jr., M. B. Hermel, and J. Gershon-Cohen (J. Q. Griffith, Jr., Foundation for Medical Research, Philadelphia and Albert Einstein Medical Center, Philadelphia). Radiology 76, 110-12(1961) Jan.

Irradiation to the adrenal in the rat will lessen the rise of blood corticosterone level after stimulation by ACTH in-

jection and, under certain conditions, slightly depress the unstimulated corticosterone level. This depression, however, under the conditions of the experiment, was not sufficient to produce adrenal deficiency or impair the general health of the animal. (auth)

7226 SOME EFFECTS OF IONIZING RADIATION ON TRANSLOCATION IN PLANTS. Kenneth L. Webb and Richard H. Hodgson (Ohio State Univ., Columbus). Science 132, 1762-3(1960) Dec. 9.

Petioles and apical regions of Phaseolus vulgaris var. Black Valentine were subjected to ionizing radiation to study the effect on the translocation process. Petiole irradiation produced no discernible effect. Inhibition of translocation to the irradiated meristems was reversed by application of the auxin naphthaleneacetic acid. (auth)

7227 THERMAL ANNEALMENT AND NITRIC OXIDE EFFECTS ON FREE RADICALS IN X-IRRADIATED CELLS. C. F. Ehret, B. Smaller, E. L. Powers, and R. B. Webb (Argonne National Lab., Ill.). Science 132, 1768-9(1960) Dec. 9.

Four kinds of radicals are identified in dry spores (Bacillus megaterium) after x irradiation: those associated with single, doublet, triplet, and oxygen-complex types of spectra. The singlet, present only at low temperatures, gives rise irreversibly to the doublet at 25°C. All hyperfine structure is depressed after annealment at 100°C and is lost when oxygen or nitric oxide is added. The physical results support the hypothesis that reactions of long-lived free radicals can account for the radiobiological phenomena of thermorestoration, nitric oxide protection, and latent oxygen effect. (auth)

7228 A FUNCTIONING KIDNEY HOMOTRANSPLANT IN THE DOG. John A. Mannick, Harry L. Lochte, Jr., Charles A. Ashley, E. Donnall Thomas, and Joseph W. Ferrebee (Columbia Univ. Mary Imogene Bassett Hospital, Cooperstown, N. Y.). Surgery 46, 821-8(1959) Oct.

A male beagle dog was given supralethal whole-body irradiation with Co^{60}, 1300 r in a 12-hr period. Eight days after irradiation he received an infusion of homologous bone marrow from an unrelated female beagle. The marrow graft was successful. Female leukocytes appeared in the peripheral blood in normal number. Sixteen days after the marrow graft a kidney was transplanted from the female into the male. Ten days later the male's own kidneys were removed. Except for a brief period of adjustment, blood urea and electrolyte concentrations remained normal. The homotransplanted kidney functioned normally until the death of the animal from intercurrent pneumonic disease 49 days after kidney transplantation and 73 days after irradiation. At autopsy the homotransplanted kidney showed no gross or microscopic abnormality. (auth)

7229 MODIFICATION OF THE RADIOSENSITIVITY OF SACCHAROMYCES CEREVISIAE BY NITROGEN AND GLUCOSE DEFICIENCIES. E. Greve (Universität, Freiburg i. B.). Z. Naturforsch. 15b, 666-70(1960) Oct. (In German)

Yeasts of the Saccharomyces cerevisiae (Weihenstephan) strain were irradiated with x radiation at a dose rate of approximately LD_{50}. The radiation effect on divided and resting cultures was compared, and it was established that the nuclear phase in the phase investigated had no more effect on the radiation sensitivity than the physiological state of the cells insofar as the divisibility of the cells is concerned. The radiation effect on yeast was also investigated under vaious feeding conditions. It was proved that the removal of glucose for a short time (2 hr) significantly increases the radiosensitivity, and to the same extent as a 3-day glucose deficiency. The short-time removal of nitrogen sources does not affect the radiosensitivity. After a 3-day nitrogen deficiency, the radiation damage is increased, but not as strongly as in glucose deficiency. (tr-auth)

7230 ANALYSIS OF THE RADIO-INDUCED ELECTROLYTE MODIFICATIONS IN KIDNEY SECTIONS. H. Breuer and H. K. Parchwitz (Chirurgische Universitätsklinik und Poliklinik, Bonn). Z. Naturforsch. 15b, 671-5 (1960) Oct. (In German)

The effect of x irradiation (14,000 r to 58,000 r) on the movements of potassium and sodium in guinea pig kidney cortex slices after incubation under various conditions was investigated. In addition, the oxygen uptake of the tissue slices was measured. The concentration gradients of potassium and sodium between slices and medium were reduced after x irradiation. However, this reduction was only found when the slices were incubated at 37°C. At lower temperatures no effect of x irradiation was observed. The oxygen uptake of the kidney cortex slices remained unaffected by x irradiation. The experiments described in the present paper suggest that x irradiation acts on the ion transport mechanism itself rather than on energy-supplying processes. (auth)

Radiation Sickness

7231 COMPARATIVE EFFECTIVENESS OF ISOLOGOUS AND HETEROLOGOUS BONE MARROW IN ESTABLISHING THE HEMATOPOIETIC FUNCTION IN IRRADIATED MICE. N. F. Barakina (Severtsov Inst. of Animal Morphology, Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R. 133, 1247-50(1960) Aug. 11. (In Russian)

Inbred mice of the C-57 line (black) were injected intravenously and interperitoneally with isologous bone marrow from C-57 mice and with heterologous bone marrow from white rats after receiving an x ray dose of 700 r. Part of the mice were sacrificed at intervals of 2, 5, and 8 days after irradiation, and the bone marrow was fixed by Zenker's solution containing acetic acid and methyl alcohol in order to follow the histological changes. The number of survivals at 30 days was 82.9% for intravenous injection and 45.4% for intraperitoneal injection with isologous bone marrow. The corresponding figures were 51.7% and 25.0% for injection with heterologous bone marrow. Analyses of the blood cell groups showed that intravenous injection was more effective than intraperitoneal injection in establishing the hematopoietic function, and that the use of isologous bone marrow was more effective than heterologous bone marrow. (TTT)

7232 THE ACTION OF METHYL-METHIONINE-SULFONIUM CHLORIDE (MMS) ON THE BLOOD CELL POPULATION IN THE WHITE RAT. PLATELET COUNT. M. Candura (Università, Pavia, Italy), T. Villa, and F. Candura. Folia Med. (Naples) 43, 870-80(1960) Sept. (In Italian)

Sulfon-methyl-methionine had no effect on the number or morphology of blood platelets in irradiated rats. Preliminary studies indicated a radioprotective effect for this compound. 35 references. (C.H.)

7233 INFLUENCE OF METHYL-METHIONINE-SULFONIUM CHLORIDE (MMS) ON THROMBOCYTE COUNT IN THE IRRADIATED RAT. M. Candura (Università, Pavia, Italy), T. Villa, and A. Pisani. Folia Med. (Naples) 43, 881-7(1960) Sept. (In Italian)

Results are reported from a study of the blood picture in rats following the administration of sulfon-methyl-

methionine chloride. Preliminary studies suggested a radioprotective action by this drug. Results are included from studies on the sulfhydryl content and metabolic effects of thrombocyte enzymes. (C.H.)

7234 RADIATION INJURIES IN X-RAY AND RADIUM THERAPY AND THEIR TREATMENT. A. I. Strashinin (Central Scientific Research Inst. of Medical Radiology, Ministry of Public Health, USSR). Problems Oncol. (U.S.S.R.) (English Translation), 6, 917-33(1960).

Recent developments have been made in sources for supervoltage irradiation therapy which allow the irradiation of patients under mobile irradiation conditions as well as from stationary sources. Irradiation doses have also been increased. Reactions of the human body to the effects of irradiation are reviewed. The general constitutional disturbances which have been observed during the course of radiation therapy are designated as the general reaction to irradiation (GRI). Various symptoms and manifestations of this condition are described. The uses of various chemical and biological agents for the prophylaxis and therapy of the GRI are discussed. The clinical features and treatment of local radiation lesions are also discussed. The carcinogenic effect of radiation used for therapeutic purposes is also considered. It is concluded that the problems of radiation damage caused by the use of x-ray and radium therapy have not been fully resolved. 116 references. (C.H.)

CHEMISTRY

General and Miscellaneous

7235 (CEA-1668) SENSIBILITE ACCRUE DU DOSIMETRE A SULFATE FERREUX DE FRICK PAR L'UTILISATION DU REACTIF A L'ORTHOPHENANTHROLINE. (Relating to the Higher Sensitiveness of Frick Ferrous Sulfate Dosimeter by the Use of Orthophenantroline Reagent). H. Bouzigues, J. Scheidhauer, R. Brian, and L. Messainguiral (France. Commissariat à l'Énergie Atomique. Centre d'Études Nucléaires, Saclay). 1960. 10p.

A description is given of a possible utilization of a ferrous sulfate dosimeter with ferrous orthophenantroline as a way of determining the absorbed dose. The process was applied to measurement of the γ radiation of Co^{60} and the relative middle values of $G_{Fe^{++}}$ determined with an accuracy of ±2.75% of dose rate in the range from 1,000 to 30,000 rads. The chief advantage concerns the colored complex, which is particularly stable. (auth)

7236 (CF-59-5-77) DETERMINATION OF THICKNESS OF OXIDE FILM ON PHOSPHOR BRONZE. J. C. White (Oak Ridge National Lab., Tenn.). May 19, 1959. 4p.

The thickness of an oxide film on phosphor bronze helices was determined by first establishing the oxygen content of the helix "as received" and after cleansing with nitric acid. Based on the assumption that the difference between the two values was the oxygen in the film, and that the film consisted entirely of cupric oxide, the thickness of the film was calculated from the density of cupric oxide, weight of film, and surface area of film. A value of 1080 A was calculated as the thickness by this method. (auth)

7237 (DP-513) NITRIC ACID SPECIES IN TRI-n-BUTYL PHOSPHATE SOLUTIONS. Woodfin E. Schuler (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). Sept. 1960. 29p. Contract AT(07-2)-1.

Partition data, physical properties, and spectroscopic data indicate the formation of these complexes in solutions of tri-n-butyl phosphate and nitric acid: $TBP \cdot H_2O$, $TBP \cdot H_2O \cdot HNO_3$, $TBP \cdot HNO_3$, $TBP \cdot H_2O \cdot 2HNO_3$, $TBP \cdot H_2O \cdot 3HNO_3$, and $TBP \cdot 4HNO_3$. Tri-methyl, tri-ethyl, and tri-n-butyl phosphate show no evidence of existence of rotational isomers. (auth)

7238 (GAT-T-809) REACTIONS OF MOLYBDENUM, TUNGSTEN AND URANIUM HEXAFLUORIDES WITH NITROGEN COMPOUNDS. III. NITROGEN DIOXIDE AND NITROGEN OXYHALIDES. J. R. Geichman, P. R. Ogle, and L. R. Swaney (Goodyear Atomic Corp., Portsmouth, Ohio). Jan. 27, 1961. 9p. Contract AT(32-2)-1.

Reaction between gaseous nitrogen dioxide and gaseous uranium hexafluoride results in the formation of the nitrylium salt NO_2UF_6. Under similar conditions no reaction occurs between nitrogen dioxide and molybdenum and tungsten hexafluorides. Reaction between nitrosyl and nitryl fluorides and the three hexafluorides results in solid compounds of the composition $NO_xF \cdot MF_6$, where x is 1 or 2 and M represents Mo, W, or U. Reaction between gaseous or liquid nitrosyl chloride and molybdenum and uranium hexafluorides results in the formation of the nitrosylium salts $NOMoF_6$ and $NOUF_6$ and chlorine. Tungsten hexafluoride was found not to react with nitrosyl chloride. The conditions and stoichiometry of the reactions are described. The nitrylium salt, NO_2UF_6, is characterized, and some of its physical and chemical properties are described. The $NO_xF \cdot MF_6$ compounds are characterized, and some physical properties are described. Evidence for the presence of NO^+ and MF_7^- ions in these compounds is given. The nitrosylium salts, $NOMoF_6$ and $NOUF_6$, were characterized previously. (auth)

7239 (NP-9738) THE SYNTHESIS OF UNSATURATED FLUOROCARBONS. Quarterly Report No. 37 [for] June 13, 1960—September 13, 1960. Paul Tarrant and Eugene C. Stump, Jr. (Florida. Univ., Gainesville). 31p. Project No. 7-93-15-004. Contract DA-19-129-QM-500.

Research is reported on the preparation of unsaturated organic compounds containing fluorine. When synthetic methods were developed, efforts were made to prepare various fluoroolefins that may give elastomers which are oil- and fuel-resistant and which retain their elasticity at low-temperatures. A study was made of the peroxide and ultraviolet-catalyzed free-radical addition of bromotrichloromethane, dibromodifluoromethane, and 1,2-dibromo-2-chloro-1,1,2-trifluoroethane to alkenyl alkyl ethers. One-to-one addition products were obtained in each case, with radical attack occurring at the terminal methylene carbon atom. (W.L.H.)

7240 (NP-9773) INVESTIGATION OF PHENYLENE SULFIDE POLYMERS. Quarterly Progress Report No. 3, October 15, 1960—January 15, 1961. H. A. Smith (Dow Chemical Co., Midland, Mich.). 19p. Project No. 7340. Contract AF33(616)-7251.

Research on phenylene sulfide polymers continued in monomer synthesis, and reaction investigations. Other lines of investigation included melt viscosity on the polymer and crosslinking of Macallum or linear polymers. The thianthrene side reaction in the preparation of bis-(p-iodophenyl) disulfide from iodine and thiophenol was eliminated. From this disulfide, the sodium salt of p-iodothiophenol was synthesized. High purity sodium salts of p-fluorothiophenol and thiophenol and the lithium salt of thiophenol were also made. Preparation of cuprous salts with thiophenols is reported, but their synthesis from disulfides led to polymerization. Rate investigations on the reaction of sodium thiophenoxide with p-dibromo and p-diiodobenzene was continued. Use of a gas chromatograph

enabled more direct product analysis and consequently more consistent rate constant ratios. Solution work showed that the rates of reaction are greatly enhanced by the solvent although the ratios remain unchanged. It was also shown that by-product formation is not due to product degradation. Polymerization of sodium p-fluorothiophenoxide showed that fluorine is less replaceable than chlorine. Thus, the ease of replaceability appears to be F < Cl < Br < I. (auth)

7241 (NYO-8778) THE STRUCTURE AND SPECTRA OF NICKEL(II) AND COPPER(II) COMPLEXES. W. Manch and W. Conard Fernelius (Pennsylvania State Univ., University Park). Aug. 1960. 28p. Contract AT(30-1)-907. OTS.

A simple theory (crystal field) based on ionic bonding and like-charge repulsion is discussed. In terms of this theory a connection between the magnetic moment and structure is not needed. The theory also leads to a more meaningful connection between the spectrum of a complex and its structure. (W.L.H.)

7242 (TID-11356) TECHNICAL PROGRESS REPORT [ON CHEMISTRY FOR] APRIL 1, 1960 TO DECEMBER 24, 1960. Lynne L. Merritt, Jr. (Indiana Univ. Foundation Research Div., Bloomington). 14p. Contract AT(11-1)-120.

Work on the crystal structure of 2-methyl-8-hydroxyquinoline-5-sulfonic acid, 8-hydroxyquinaldine, and dimethylglyoxime is reported. Solubility studies are reported on bis-(3,5-dibromoanthranilate)-cobalt(II). Work on coulometry at controlled potentials is also reported. (W.L.H.)

7243 (UCRL-9332) OXIDATION POTENTIAL OF THE Ce(III)–Ce(IV) COUPLE AS A FUNCTION OF TEMPERATURE IN PERCHLORIC ACID SOLUTIONS—THERMODYNAMIC PROPERTIES (thesis). Harry Lee Conley (California. Univ., Berkeley. Lawrence Radiation Lab.). Aug. 22, 1960. 45p. Contract W-7405-eng-48.

The temperature coefficient of the cerous-ceric oxidation potential was measured in molal perchloric acid. E_f, dE_f/dT, ΔH, ΔF, ΔS, and ΔC_p were determined for the reactions (1) $Ce(OH)^{3+} + \frac{1}{2} H_2 = Ce^{3+} + H_2O$ and (2) $Ce^{4+} + \frac{1}{2} H_2 = Ce^{3+} + H^+$ at 25°C and a total cerium concentration of zero. E_f for reaction (1) is in good agreement with the value found by Sherrill, King, and Spooner. ΔH, ΔF, and ΔS values for reaction (1) at ceric perchlorate concentrations of 0.005 and 0.025 molal were also determined and found to be in good agreement with the calorimetric values of Evans and Fontana. Evans and Fontana worked with ceric perchlorate concentrations of 0.005 and 0.025 molal, respectively, in half molal perchloric acid. From the temperature coefficient of the equilibrium constant K_D, ΔH, ΔF, and ΔS were determined for the reaction $2\ Ce(OH)^{3+} = Ce\text{-}O\text{-}Ce^{6+} + H_2O$ at 25°C. These results were compared with those of Hardwick and Robertson. (auth)

7244 (WADD-TR-60-56(Pt.I)) A COMPENDIUM OF THE PROPERTIES OF MATERIALS AT LOW TEMPERATURE (PHASE I). PART I. PROPERTIES OF FLUIDS. [Period covered]: January 1958 to March 1959. Victor J. Johnson, ed. (National Bureau of Standards. Cryogenic Engineering Lab., Boulder, Colo.). Aug. 1960. 444p. Project No. 7360. Contract AF33(616)-58-4. OTS.

This first phase of the compendium covers ten properties of ten fluids. Density, expansivity, thermal conductivity, specific heat and enthalpy, transition heats, phase equilibria, dielectric constants, adsorption, surface tension, and viscosity for the solid, liquid, and gas phases of helium, hydrogen, neon, nitrogen, oxygen, air, carbon monoxide, fluorine, argon, and methane are given wherever adequate data could be collected. Data sheets, primarily in graphic form, are presented from "best values" of data collected. The source of the material used and other references and tables of selected values with appropriate comments are furnished with each data sheet to document the data presented. Conversion tables and other helpful information are also included. (auth)

7245 (NP-tr-551) STUDY OF THE EQUILIBRIA OF DISTRIBUTION OF PICRIC ACID BETWEEN WATER AND NITROBENZENE (I). S. V. Gorbachev and E. Ya. Mindovich. Translated by V. Beak (U.K.A.E.A. Atomic Energy Research Establishment, Harwell) from Zhur. Fiz. Khim. 27, 1837-41(1953). 11p.

The dependence of the distribution of picric acid between water and nitrobenzene on its initial concentration at 20°C and on temperature at various concentrations was investigated. An apparatus was described which ensured that the experiments be conducted under uniform conditions. Shilov's equation, $K = (C_w)^n/C_n$, where K is the distribution coefficient, and C_w and C_n are the equilibrium concentrations of the water and nitrobenzene, was used to obtain a value $K = 1.068 \times 10^{-4}$ when a value of 2.52 is used for the exponent n, which was determined from the slope of the line connecting the experimental points. This distribution coefficient was found to be constant and not dependent on the initial concentration. The investigation indicated that the values of both n and K were functions of temperature. The functional dependence of the value of n was expressed as the product: $n\ T = B = 738$. The dependence of K was expressed by a linear equation: $\log K = -(\psi/RT) + \text{const.}$, or $\log K = (A/T) + \text{const.}$ A graphical method was used to find ψ, the change in potential energy when 1 mole of picric acid passes between phases; the value was 9380 cal/mole. The distribution dependence on initial acid concentration and on temperature was expressed as: $(C_w)^{(B/T)}/C_n = K_1 e^{-(A/T)}$. (B.O.G.)

7246 (UCRL-Trans-619(L)) COLLOID SYNTHESES BY TITANIUM(III)-CHLORIDE. REPORT V. COLLOID BISMUTH AND COLLOID ANTIMONY. A. Gutbier, Berta Ottenstein, and F. Allam. Translated by Richard B. Mudge from Z. anorg. u. allgem. Chem. 164, 287-96(1927). 13p.

For the production of colloid bismuth, the following procedure is outlined: into a solution of 1 part by vol. $TiCl_3$(17%) plus 4 parts by vol. of 5% sodium acetate, is placed 5 parts by vol. of a $Bi(OH)_3$ suspension (1:100). Immediate reduction takes place and colloidal bismuth is formed. The colloid is dark brown in transmitted light and black in reflected light. The synthesis was made at room temperature. In the preparation of colloidal antimony, 10 cm^3 of a pre-treated $TiCl_3$ solution are diluted with water to 10-fold vol. and heated to boiling; the solution becomes blue and a slight opalescence develops. To this solution 50 cm^3 of thoroughly agitated $SbCl_3$ suspension are added with constant stirring. The mixture is clarified in the first moment, but immediately begins to become brownish in color and in a few seconds the solution becomes deep black. When viewed by transmitted light it appears to be deep brown. The liquid is poured at once into a small parchment paper sack and subjected to dialysis. (W.L.H.)

7247 A STUDY OF THE COMPLEX FORMATION OF CERTAIN α-HYDROXYACIDS WITH YTTRIUM AND CERIUM. Vikt. I. Spitsyn and O. Voĭtekh (Moscow State Univ.). Doklady Akad. Nauk S.S.S.R. 133, 613-16(1960) July 21. (In Russian)

Yttrium-91 and Ce^{144} tracers were used to determine the

distribution of these rare earths between a cation resin (KU-2 cross-linked with 8% DVB) and a solution of an α-hydroxy acid such as glycolic acid, lactic acid, α-hydroxy isobutyric acid, α-hydroxy isovaleric acid, and α-hydroxy isocaproic acid. The total concentration of the organic complexing agent was held constant at 0.005 M, 0.05 M, and 0.2 M at a variable pH, and an additional series of experiments were run at a constant pH and a variable total concentration of organic complexing agent. The results from both series of experiments gave analogous results. The stability constants of the cerium and yttrium complexes of these hydroxy acids were calculated. It was found that α-hydroxy isobutyric acid was the strongest complexing agent for cerium and yttrium. (TTT)

7248 RELEASE OF RADIOACTIVE INERT GAS LABEL FROM SURFACES OF SOLIDS DURING HYDRATION AND DEHYDRATION. Čestmír Jech (Inst. of Physical Chemistry, Czechoslovak Academy of Science, Prague). Intern. J. Appl. Radiation and Isotopes 8, 179-85(1960) Oct. (In English)

The results show that both the processes of incorporation of water into, as well as its removal from, the surface structure of solids are accompanied by the release of a fraction of the inert gas label, introduced there by ionic bombardment. The extent and time dependence of the release during surface hydration are dependent on the nature and porosity of the labeled substance. By following the release in the course of thermal dehydration, it is possible to discern initial stages of individual dehydration steps. The method can provide new information on changes produced in the structure of the outermost layers of a solid during processes of adsorption and desorption. (auth)

7249 PREPARATION AND FERROELECTRIC PROPERTIES OF DEUTERATED TRIGLYCINE SULFATE. V. P. Konstantinova, I. M. Sil'vestrova, L. A. Shuvalov, and V. A. Yurin. Izvest. Akad. Nauk S.S.S.R., Ser. Fiz. 24, 1203-8 (1960) Oct. (In Russian)

Deuterated triglycine sulfate crystals are useful as tracers for studying the properties of the compound; they are also of great interest for establishing the effect of the replacement of hydrogen by deuterium on the physical properties of the compound. Deuteration was accomplished by the crystallization of the compound from heavy-water solution; a more completely deuterated compound was prepared by recrystallizing the material from a glycocoll + H_2SO_4 medium dissolved in heavy water. The Curie point of the deuterated material was found to be higher, (58.9°C) than the value of 47 to 49.6°, reported in the literature for the ordinary material. Optical properties of the two materials are very similar. The temperature dependence of the dielectric constant shows the hysteresis loop, characteristic for ferroelectric materials; the shape of this loop is different from that of the nondeuterated crystal. They can be used on a wide range of temperatures. (TTT)

7250 STUDIES OF REACTIONS BETWEEN URANIUM DIOXIDE AND GRAPHITE. B. Craven and Eric R. McCartney (Univ. of New South Wales, Sydney). J. Am. Ceram. Soc. 44, 12-15(1961) Jan.

Studies of the reactions at 1650 to 2130°C were performed using 3-g pellets formed from UO_2 powder of particle size ~0.9 μ with graphite powder beds compressed around the pellets. After heating in an argon stream for the required period of time, the material was immersed in water to cool and the pellet removed from its graphite bed for cross-sectional examination; the layer that formed on the pellet surface was identified by x-ray diffraction and its thickness measured. The pellets in the 1650 and 1760°C runs formed a UC layer, although the thickness data as a function of time showed a wide scatter. Likewise, the runs between 1800 and 2000°C showed a UC layer, while the runs above 2000°C formed a UC_2 layer at the pellet-graphite interface in addition to the UC layer, indicating the reaction $UC + C \rightarrow UC_2$. Plots of layer thickness of the UC layer vs. square root of time for the 1800 to 2130°C runs gave straight lines, indicating that a parabolic rate law is obeyed, and an Arrhenius plot of the rate constants gave an activation energy of 63 ± 6 kcal/mole for UC formation. Similar plots for the UC_2 layer indicate a parabolic rate law and an activation energy of ~40 kcal/mole for UC_2 formation. (D.L.C.)

7251 THE HYDROLYTIC BEHAVIOR OF THORIUM(IV)-PYROCATECHOL-3,5-DISULFONATE. Yukito Murakami and Arthur E. Martell (Clark Univ., Worcester, Mass.). J. Am. Chem. Soc. 82, 5605-7(1960) Nov. 5.

Potentiometric measurements are described for aqueous systems containing 4 : 1, 3 : 1, 2 : 1, and 1 : 1 moles of Tiron (disodium pyrocatechol-3,5-disulfonate) per mole of thorium(IV) salt in 0.1 M potassium nitrate solution. For ligand/metal ratios of 1.5 : 1 or higher the same compound is formed initially, regardless of the excess ligand present. The nature of the 1.5 : 1 compound is established by spectrophotometric and potentiometric studies. Extensive hydrolysis of the metal chelate takes place at all ratios of ligand to metal ion studied, but no precipitation occurs over the wide pH range investigated. (auth)

7252 SOLVENT EXTRACTION STUDIES ON THE 1 : 1,5 THORIUM(IV)-PYROCATECHOL-3,5-DISULFONATE SYSTEM. Raymond F. Bogucki, Yukito Murakami, and Arthur E. Martell (Clark Univ., Worcester, Mass.). J. Am. Chem. Soc. 82, 5608-10(1960) Nov. 5.

The application of solvent extraction measurements to the determination of the degree of polymerization of metal chelate compounds was investigated using the 1 : 1.5 Th(IV)-pyrocatechol-3,5-disulfonate (Tiron) system. The distribution of Th^{234} tracer between a cyclohexane phase containing thenoyltrifluoroacetone and an aqueous phase containing Tiron was determined at various thorium concentrations. Mathematical treatment of the data obtained has shown that the 1 : 1.5 Th(IV)-Tiron chelate is binuclear at pH 4.3. (auth)

7253 ULTRACENTRIFUGATION OF 1 : 1 Th(IV)-DIETHYLENETRIAMINEPENTAACETIC ACID AND 1 : 1.5 Th(IV)-PYROCATECHOL-3,5-DISULFONATE CHELATES. Richard L. Gustafson and Arthur E. Martell (Clark Univ., Worcester, Mass.). J. Am. Chem. Soc. 82, 5610-16(1960) Nov. 5.

The application of ultracentrifuge measurements to the determination of molecular weights of charged metal chelates was investigated using the 1 : 1 Th(IV)-diethylenetriaminepentaacetate (DTPA) and 1 : 1.5 Th(IV)-pyrocatechol-3,5-disulfonate (Tiron) systems. The Archibald non-equilibrium method of determining molecular weights as described by Klainer and Kegeles was applied to the methods of dealing with charged polymers as outlined by Johnson, et al. The calculated values of the molecular weight of the monomeric Th(IV)-DTPA chelate (which was employed as a model system) were approximately 10 per cent lower than the actual value, presumably because of the fact that a nonideal supporting electrolyte, 1 M $NaNO_3$, was employed. The substitution of KNO_3 for $NaNO_3$ resulted in molecular weight values which were only 3 per cent below the theoretical value. Investigation of the 1 : 1.5 Th(IV)-Tiron system of 1 M NaCl showed that a binuclear chelate is the predominant species. The effects of varying type and concentration of the supporting electrolyte were

studied and discussed in terms of the primary and secondary salt effects. (auth)

7254 STABILITY RELATIONSHIPS AMONG THE RARE EARTH ACETYLACETONATES. Ingmar Grenthe and W. Conard Fernelius (Pennsylvania State Univ., University Park). J. Am. Chem. Soc. 82, 6258-60(1960) Dec. 20.

Step-wise stoichiometric formation constants were determined for the reaction between acetylacetone and the rare earths including yttrium. The measurements were made at a temperature of 30°C in 0.1 M aqueous perchlorate. A plot of the logarithm of the first formation constant against the ionic potential shows a linear relation from lanthanum to europium with a change of 0.15 in log K_1 between consecutive elements. After gadolinium the stability remains nearly constant with a total change in log K_1 from terbium to lutetium of 0.2. This relation between the ionic potential and log K is compared with the same relation for other rare-earth complexes. (auth)

7255 REACTIONS BETWEEN HYDROCARBONS AND DEUTERIUM ON CHROMIUM OXIDE GEL. I. GENERAL. Robert L. Burwell, Jr., A. B. Littlewood, M. Cardew, G. Pass, and C. T. H. Stoddart (Northwestern Univ., Evanston, Ill.). J. Am. Chem. Soc. 82, 6272-80(1960) Dec. 20.

Sites for hydrogenation of olefins and for isotopic exchange between alkanes and deuterium are simultaneously developed by heating chromium oxide gel to higher temperatures. Above 470°C, the rate of loss of surface exceeds the rate of site production. There is little interaction among sites. Chromium oxide gel also catalyzes double bond migration but on sites which, at least in part, differ from those involved in hydrogenation and exchange. The major processes, simple isotopic exchange of one atom per adsorption step and simple cis-addition of deuterium atoms to the double bond, involve a monoadsorbed alkane which cannot revert to a diadsorbed alkane at temperatures below 300°C. It seems probable that olefin reacts with a surface hydrogen atom to form monoadsorbed alkane without proceeding through diadsorbed alkane. The preference for exchange of primary hydrogen atoms and the relative rates of exchange of a series of hydrocarbons suggest that the transition state separating alkane and monoadsorbed alkane involves some small contribution from carbanion. The very rapid exchange of cyclopropane probably results not only from this but also from isovalent hyperconjugation with surface sites in which a d-p π-bond is involved. The minor processes, multiple deuteration in isotopic exchange and the spreading of isotopic distribution patterns in the addition of deuterium to olefin, cannot, in general, involve gas phase olefin as an intermediate. Because of the absence of the minor processes in ethane exchange and in the deuterogenation of ethylene, it seems probable that an adsorbed allylic species is the intermediate. (auth)

7256 REACTIONS BETWEEN HYDROCARBONS AND DEUTERIUM ON CHROMIUM OXIDE GEL. II. ISOTOPIC EXCHANGE OF ALKANES. G. Pass, A. B. Littlewood, and Robert L. Burwell, Jr. (Northwestern Univ., Evanston, Ill.). J. Am. Chem. Soc. 82, 6281-3(1960) Dec. 20.

Chromium oxide gel develops significant catalytic activity for isotopic exchange between alkanes and deuterium only after it has been heated above 300°C. A treatment temperature of about 470°C results in maximum activity. Higher temperatures lead to declining activity. Exchange is readily measurable on an optimally activated catalyst at 200°C. Two isotopic exchange processes occur simultaneously. The predominant one leads to the exchange of one hydrogen atom per period of adsorption; the minor one leads to extensively exchanged alkane. With hexane, the fraction of total exchange represented by the minor process increases throughout the temperature interval 200 to 350°C. The general characteristics of isotopic exchange including activation energy are independent of the degree of activation of the catalyst. A primary hydrogen atom in propane exchanges at least six times as rapidly as a secondary one and primary hydrogen atoms in hexane exchange more readily than secondary ones. Correspondingly, neopentane exchanges somewhat faster than propane. The activation energies for exchange of propane and neopentane, 15 kcal, are essentially the same as that for hexane, 16 kcal. (auth)

7257 REACTIONS BETWEEN HYDROCARBONS AND DEUTERIUM ON CHROMIUM OXIDE GEL. III. ISOTOPIC EXCHANGE BETWEEN DEUTERIUM AND CYCLOALKANES. C. T. H. Stoddart, G. Pass, and Robert L. Burwell, Jr. (Northwestern Univ., Evanston, Ill.). J. Am. Chem. Soc. 82, 6284-6(1960) Dec. 20.

The investigation of isotopic exchange on a chromia catalyst between deuterium and these various hydrocarbons are reported: the cycloalkanes, cyclopropane to cyclooctane, methane, ethane, hexane, and 2,3-dimethylbutane. At 200°C, the rates of exchange relative to cyclohexane are: cyclopropane, 50; ethylcyclobutane and cyclooctane, 5; ethane, 0.13. The others fall in the range, 1 to 3, except for methane which is about twice ethane. The activation energies of exchange of cyclopropane and of ethane are 7 and 22 kcal. Cyclopropane exchange can be detected even at 25°C, and, at 100°C, ring opening with an activation energy of 12 kcal becomes detectable. The exchange patterns of ethane, 3,3-dimethylpentane, and cyclopropane very closely follow the random distribution characteristic of a process which introduces but one deuterium atom per adsorption step. For the others, at about 200°C, 95 to 99% of the exchanged molecules follow such a pattern. A few per cent follow a pattern involving extensive multiple exchange, and with cycloalkanes, a few per cent appear as excess cycloalkane-d_2 and -d_3. (auth)

7258 REACTIONS BETWEEN HYDROCARBONS AND DEUTERIUM ON CHROMIUM OXIDE GEL. IV. ADDITION OF DEUTERIUM TO OLEFINS. A. B. Littlewood and Robert L. Burwell, Jr. (Northwestern Univ., Evanston, Ill.). J. Am. Chem. Soc. 82, 6287-8(1960) Dec. 20.

At –78 and 0°C on a chromium oxide gel catalyst, the addition of deuterium to ethylene forms substantially pure ethane-1,2-d_2. At –11°C, about 1% alkane-d_3 and -d_4 contaminates the alkane-1,2-d_2 resulting from deuterogenation of propylene and 1-butene. At 40°C, cyclopentene gives about 2% and 1-hexene, about 5% d_3 and d_4. 2-Pentene leads to considerably more d_1 and d_3 and d_4 than 1-hexene. Increase in temperature of deuterogenation, particularly above 85°C, results in wider isotopic distribution patterns and, at 150°C, only about half of the products from 1-hexene, 2-pentene and cyclopentene is alkane-d_2. 1-Hexene in a stream of nitrogen is extensively isomerized on chromia at 200°C. At 125 and at 200°C with partially activated catalysts which give incomplete deuterogenation, the unreacted olefin is both isomerized and isotopically exchanged, but, at 50°C and below, the unreacted olefin is negligibly isomerized or exchanged. (auth)

7259 REACTIONS BETWEEN HYDROCARBONS AND DEUTERIUM ON CHROMIUM OXIDE GEL. V. STEREOCHEMISTRY. Martin Cardew and Robert L. Burwell, Jr. (Northwestern Univ., Evanston, Ill.). J. Am. Chem. Soc. 82, 6289-91(1960) Dec. 20.

The addition of deuterium to cis- and trans-2-butene catalyzed by chromium oxide gel at about 0°C proceeds by

cis-addition and leads to the formation of meso- and dibutane-2,3,-d_2, respectively. The intrusion of any trans-addition process does not exceed 10%. The hydrogenation of 1,2-dimethylcyclohexene at 100°C is less stereoselective; cis- and trans-dimethylcyclohexane are formed in a ratio of about one. The lowered stereoselectivity probably results from isomerization of 1,2- to 2,3-dimethylcyclohexene or to methyl methylenecyclohexane before hydrogenation. The latter two compounds could hydrogenate to either cis- or trans-dimethylcyclohexane by cis-addition. (+)3-Methylhexane undergoes isotopic exchange with deuterium accompanied by a small amount of racemization. The racemization probably results from that process which leads to the formation of extensively multiply exchanged species in isotopic exchange. (auth)

7260 SOME DEUTERIUM ISOTOPE EFFECTS. III. AN INVERSE γ-DEUTERIUM ISOTOPE EFFECT. K. T. Leffek, J. A. Llewellyn, and R. E. Robertson (National Research Council, Ottawa). J. Am. Chem. Soc. 82, 6315-18 (1960) Dec. 20.

Alpha-, beta-, and gamma-deuterium isotope effects were measured for the hydrolysis reactions in water of four n-propyl compounds. Interpretation of the α- and β-kinetic isotope effects follows existing theory. The γ-effect is attributed to inhibition of vibrations involving the γ-CH_3 group by increased intramolecular van der Waals forces arising in the transition state of the reaction. (auth)

7261 SECONDARY DEUTERIUM ISOTOPE EFFECTS IN THE REACTIONS OF CARBOXYLIC ACID DERIVATIVES. Myron L. Bender and Mary S. Feng (Illinois Inst. of Tech., Chicago). J. Am. Chem. Soc. 82, 6318-21(1960) Dec. 20.

Ethyl acetate-d_3, acetyl chloride-d_3, and acetic anhydride-d_6 were synthesized. The effect of β-deuterium substitution on the rates of hydrolysis of these carboxylic acid derivatives was determined. In the basic hydrolysis of ethyl acetate in aqueous solution at 25.0°C, $k_H/k_D = 0.90$, a reverse isotope effect. In the hydrolysis of acetyl chloride in 10% and 20% water-acetone (v./v.) at −22°C, $k_H/k_D = 1.51$ and 1.62, respectively. The solvolyses of acetyl chloride in cyclohexane containing 0.2665 M ethanol and in 5% water-acetone at 25.0°C and the solvolysis of acetic anhydride in water at 20.0°C showed essentially no secondary deuterium isotope effect. The secondary deuterium isotope effects that occur in the saponification of ethyl acetate and in the hydrolysis of acetyl chloride in 10% and 20% water-acetone can be explained in terms of differences in hyperconjugation in the ground and transition states of these hydrolysis reactions. It is postulated that the transition state of the hydrolysis of acetyl chloride is similar to an acylium ion and that this increase in positive charge leads to an isotope effect in the same direction as that found in Sn1 solvolyses. Its magnitude depends on the amount of positive charge developed in the transition state, which in turn is a function of the solvating power and dielectric constant of the medium. It is predicted that the secondary deuterium isotope effect in the hydrolysis of ethyl acetate should be the reverse of that found in Sn1 solvolyses, on the basis of the hyperconjugation hypothesis and the known mechanism of the reaction in which the positive charge on the carbonyl carbon atom of the ester in the ground state decreases in the transition state. (auth)

7262 SECONDARY DEUTERIUM ISOTOPE EFFECTS IN THE ADDITION EQUILIBRIA OF KETONES. John M. Jones and Myron L. Bender (Illinois Inst. of Tech., Chicago). J. Am. Chem. Soc. 82, 6322-6(1960) Dec. 20.

The equilibrium constants of reactions involving the addition of methanol to the ketones, acetone, acetone-d_6, cyclopentanone, and cyclopentanone-2,2,5,5-d_4, to form their respective hemiketals were determined. The ratio of hemiketal dissociation constants for the acetone and acetone-d_6 reactions in dioxane solution is $K_H/K_D = 1.29 \pm 0.09$. For the cyclopentanone and cyclopentanone-2,2,5,5-d_4 equilibria in methanol, the ratio, extrapolated to infinite dilution, is $K_H/K_D = 1.44 \pm 0.09$. These deuterium isotope effects indicate that the transformation of the trigonal carbonyl carbon atom of the ketone to the tetrahedral carbon atom of the hemiketal is facilitated by beta-deuterium atoms. This result is in qualitative agreement with the reverse kinetic secondary deuterium isotope effect in the hydrolysis of ethyl acetate in which a trigonal carbon atom in the ground state is transformed into an approximately tetrahedral carbon atom in the transition state. A semi-quantitative correlation of frequency changes with deuterium isotope effects in carbonyl compounds indicates that the isotope effects need not be explained in terms of electronic effects but rather may be explained solely on the basis of mass effects on the fundamental vibrational frequencies of the molecules. (auth)

7263 CHARACTERIZATIONS AND SOME CHEMICAL REACTIONS OF PERIODATE-OXIDIZED NUCLEOSIDES. Joseph X. Khym and Waldo E. Cohn (Oak Ridge National Lab., Tenn.). J. Am. Chem. Soc. 82, 6380-6(1960) Dec. 20.

Phenylhydrazine reacts with the periodate oxidation products of adenosine, guanosine, uridine, and cytidine to form bisphenylhydrazones, which were isolated and characterized. These substances react further with phenylhydrazine to form adenine, guanine, uracil, and cytosine and 2- and 3-carbon fragments. Sodium borohydride reduces both aldehyde groups of the oxidized nucleosides when the reaction is carried out under alkaline conditions, but selective reduction of the aldehyde group distal to the purine or pyrimidine ring occurs under slightly acidic conditions. Ion exchange and paper chromatographic methods were developed for the examination of the dialdehydes and the corresponding reduction products were obtained from them. Evidence is presented indicating that the acid hydrolysis of the completely reduced products, the tri-alcohols, is probably initiated at the glycosidic linkage. A new micro method for measuring and removing periodate and iodate essentially in one step was developed. (auth)

7264 EXCHANGE OF $N^{15}H_3$ BETWEEN SOLVENT AND LIGANDS IN COMPLEX METAL AMMINES. John R. Sutter and John P. Hunt (Washington State Univ., Pullman). J. Am. Chem. Soc. 82, 6420(1960) Dec. 20.

A turbulent flow apparatus was used for qualitative study of the exchange of $N^{15}H_3$ between solvent and ligands in complex metal ammines. The N^{15}-enriched liquid NH_3 was mixed in ~0.01 sec with an unenriched solution of the metal salt in liquid NH_3 below −35°C, the mixture quenched and then subjected to mass spectrometric analysis of the nitrogen from the solvent. Half times for the exchange reactions are presented for the salts $Cu(NH_3)_4(NO_3)_2$, $Ni(NH_3)_6(NO_3)_2$, AlI_3, $Al(NH_3)_6I_3$, and $Ag(NH_3)_2NO_3$; all of the half times are on the order of 1 sec or less. (D.L.C.)

7265 MYOSIN B NUCLEOSIDE TRIPHOSPHATASE IN DEUTERIUM OXIDE. Ken Hotta and Manuel F. Morales (Dartmouth Medical School, Hanover, N. H.). J. Biol. Chem. 235, PC61-3(1960) Dec.

Important differences have been noted in the way that myosin catalyzes the hydrolysis of adenosine triphosphate and of inosine triphosphate. Observations on the myosin catalysis in D_2O and H_2O may constitute evidence for the

hypothesis that in the 6 to 8 pH range ATP hydrolysis involves a rate-retarding interaction not present in ITP hydrolysis. Except for the use of D_2O, the techniques involved were the same as those described by Morales and Hotta. Representative results are given graphically as the rate of catalysis v_{max}, as a function of pH from 6 to 10. The general results are: (a) for ITPase, $V_{max}(H_2O)$ always exceeds $V_{max}(D_2O)$, and the increment increases with pH and pD; (b) for ATPase, at pH (or pD) ~7, $V_{max}(H_2O) = V_{max}(D_2O)$, but to either side the increment increases; (c) for ATPase at pH = pD = 7.2, if the enzyme is strongly activated, then $V_{max}(H_2O)$ appreciably exceeds $V_{max}(D_2O)$, and if the enzyme is mildly activated, then $V_{max}(H_2O)$ is only slightly greater than $V_{max}(D_2O)$. (B.O.G.)

7266 THE FORMATION AND PHOTOCHEMICAL OXIDATION OF URANIUM(IV) CITRATE COMPLEXES. A. Adams and T. D. Smith (Royal Coll. of Science and Tech., Glasgow). J. Chem. Soc., 4846-50(1960) Dec.

The behavior of uranium(IV) in the presence of citric acid was studied, and the stability constant of the complex formed was measured over a pH range. The stability constants measured illustrate the effect of the hydrolysis of uranium(IV). The photochemical oxidation of uranium(IV) citrate by oxygen was studied and compared with that of uranium(IV) tartrate obtained in the presence of tartaric acid. (auth)

7267 STUDY OF THE MECHANISM OF THE INTERACTION OF ELEMENTARY SULFUR WITH THIN LAYERS OF COPPER IN A HYDROCARBON MEDIUM USING RADIOACTIVE INDICATORS. M. M. Kusakov, E. A. Razumovskaya, and A. P. Dekartov. Zhur. Priklad. Khim. 33, 2466-70(1960) Nov. (In Russian)

Exact knowledge of the behavior of sulfur-containing organic additives to oils coming into contact with metallic surfaces is of great interest for the development of lubricating oils. For this purpose, the action of elementary S^{35} on very thin vacuum-deposited copper layers was investigated, mixing it with the high-boiling fraction of an oil to a concentration of 0.5%. The S^{35} + oil system was kept in contact with the metallic film at a temperature of 120°C for periods ranging from 30 to 180 min. By using various film thickness, the depth of penetration of the metal into the system could be determined. It was found that the amount of CuS formed, as determined by its activity, is proportional to the thickness of the metallic film. The thickness value calculated from the activity agreed quite well with the weight data corresponding to the weight deposited per unit surface; from this it appears that β-active isotopes could be very useful for measuring the thickness of very thin metal layers. The experimentally determined sulfide layer was about 3 times thicker than the metal layer, which agrees quite well with stoichiometric considerations. (TTT)

7268 DETERGENT COMPOSITION. David Gordon Stevenson (to United Kingdom Atomic Energy Authority). British Patent 856,377. Dec. 14, 1960.

A detergent composition suitable for removing radioactive metal contamination from objects and materials contains a synthetic surface active agent, a water-soluble polycarboxylic acid containing the group $-N(CH_2COOH)_2$, a water-soluble nitrogen-free polycarboxylic acid, and an alkali metal or ammonium base to set up a buffer system of pH 3 to 9. The decontamination is more efficient if the metal forms an anionic complex with the acid containing the group $-N(CH_2COOH)_2$, and any quadrivalent ions such as Pu^{4+} should be reduced since they would form neutral complexes. The preferred components of the composition are C_{10} to C_{15} alkyl sulfate, ethylenediaminetetraacetic acid or ammonia triacetic acid, and citric acid or oxalic acid. Where the contaminated surface is metallic, a source of fluoride ions should be added. Examples of the use of this composition are given in which Ce^{144}, Sr^{90}, and Pu^{239} contamination is removed from cotton twill, aluminum, and stainless-steel. A graph is included which illustrates the effect of pH on the removal of Ce^{3+} and Sr^{2+} from cotton twill. (D.L.C.)

7269 IMPROVEMENTS IN OR RELATING TO THE CONVERSION OF METAL OXIDES TO CHLORIDES. Allan Robert Gibson (to United Kingdom Atomic Energy Authority). British Patent 856,462. Dec. 14, 1960.

A method for converting thorium oxide or beryllium oxide into chlorides and subsequently electrodepositing the metals therefrom is outlined. A suspension of the oxide in a molten alkali (or alkaline earth) metal chloride is electrolyzed in a cell with a carbon anode and a carbon cathode with chlorine gas flowing over the cathode surface so that the oxide at the anode and the deposit at the cathode are converted into chlorides. When the electrolyte is free from oxide or oxychloride, the chlorine flow may be discontinued to permit thorium or beryllium deposition on the cathode. Two examples of this method are given which give 73 to 80 and 60% conversion of thorium and beryllium oxides, respectively. (D.L.C.)

7270 IMPROVEMENTS IN OR RELATING TO ION-EXCHANGE RESINS. John Kennedy and Geoffrey Ernest Ficken (to United Kingdom Atomic Energy Authority). British Patent 859,834. Jan. 25, 1961.

Methods are given for synthesizing improved ion-exchange resins containing substituted aminomethyl phosphonate groups and having an amphoteric character. The phosphonate in these resins has the formula $ROP(O)OHCR_1R_2NR_3R_4$, where R is an alkyl or aryl group, R_1, R_2, R_3, and R_4 are alkyl or aryl groups or hydrogen or comprise a unit of a polymeric chain; R_3 and R_4 together with N may form a piperidine or morpholine group. Such resins may be derived from the monomeric dialkyl or diaryl hydrogen phosphonate by reaction with a polymeric material. (D.L.C.)

7271 TREATMENT FOR IMPROVING THE OPERATION OF STRONG BASE ANION EXCHANGE RESINS. Peter C. Stevenson (to U. S. Atomic Energy Commission). U. S. Patent 2,962,351. Nov. 29, 1960.

A process is offered for improving quaternary ammonium type strongly basic anion exchange resins so that certain zinc and cadmium residues, which normally stick to and "poison" this type of resin, can be removed by elution. Specifically, the resin as obtained commercially is treated with an aqueous solution of sodium hydroxide of about 1 to 4 M concentration by heating therein and periodically adding small amounts of oxidizing agent selected from hydrogen peroxide, sodium peroxide and hypochlorite. Zinc and cadmium values may then be adsorbed onto the resin from a 0.1 to 3 M HCl and thereafter eluted therefrom with very dilute HCl solutions.

Analytical Procedures

7272 (CEA-1549) DOSAGE ABSOLU PAR DIFFRACTION X D'UN MELANGE BINAIRE OU TERNAIRE: OXYDE ET FLUORURE DE NICKEL DANS UNE POUDRE DE NICKEL. (Absolute Determination by X-ray Diffraction of

a Binary or Ternary Mixture: Nickel Oxide and Fluoride in Nickel Powder). P. Charpin and A. Hauptman (France. Commissariat à l'Énergie Atomique. Centre d'Études Nucléaires, Saclay). 1960. 12p.

The method employed is based upon the comparison between computed and measured intensities for conveniently selected x-ray diffraction lines of each component of the powder. Care must be taken to allow for absorption, both inside each grain and in the over-all sample. This method was applied to the determination of nickel oxide and fluoride in a nickel powder. (auth)

7273 (CF-59-4-71) HIGH-PRECISION DETERMINATIONS BY MEANS OF HIGH-ABSORBANCY SPECTROPHOTOMETRIC METHOD. APPLICATION TO THE DETERMINATION OF COBALT IN ALUMINUM. Oscar Menis (Oak Ridge National Lab., Tenn.). Apr. 13, 1959. 4p.

High-absorbancy spectrophotometry was applied to the precise determination of about 0.15% cobalt in aluminum by the 1-(2-pyridylazo)-2-naphthol method. The absorbancies of sample aliquots were measured versus a standard containing 50 μg of cobalt. The relative concentration error for a single measurement, assuming a 1% transmittancy error, is 0.93% and the coefficient of variation of 5 cobalt determinations is 0.5%. (auth)

7274 (CF-59-4-100) DIRECT SPECTROPHOTOMETRIC DETERMINATION OF URANIUM IN CYCLOHEXANE SOLUTIONS OF TRI-n-OCTYLPHOSPHINE OXIDE. J. C. White (Oak Ridge National Lab., Tenn.). Apr. 21, 1959. 9p.

A method for the direct determination of uranium in a cyclohexane solution of tri-n-octylphosphine oxide (TOPO) is presented. The adduct, $UO_2Cl_2 \cdot 2TOPO$, that is formed when uranium(VI) is extracted from hydrochloric acid solutions by tri-n-octylphosphine oxide absorbs light in the ultraviolet region. This absorbance is measured at 230 mμ vs. a TOPO-cyclohexane solution that was contacted with hydrochloric acid of the same concentration as that in the test aliquot. The molar absorbance index is 5500. The method is not selective; of the elements that are extracted by TOPO from hydrochloric acid, iron(III), zirconium, molybdenum, tin and thorium, only thorium can be tolerated. (auth)

7275 (CF-59-6-43) ULTRAVIOLET SPECTROPHOTOMETRIC DETERMINATION OF OSMIUM TETROXIDE IN $CHCl_3$. Gerald Goldstein (Oak Ridge National Lab., Tenn.). June 9, 1959. 9p.

A method was developed for the determination of osmium by measuring the absorbancy of osmium tetroxide in $CHCl_3$. The osmium is first oxidized to the octavalent state and the osmium tetroxide which is formed is extracted selectively with $CHCl_3$. The ultraviolet absorption spectrum of OsO_4 in $CHCl_3$ has a series of absorption bands with peak absorbancies at 282, 289, 297, 304, and 312 mμ, and molar absorbancy indices of 1870, 1760, 1640, 1400, and 1000, respectively. For each wavelength the optimum concentration range for the determination of osmium was evaluated by the method of Ringbom. Only chloride and octavalent ruthenium interfere in the determination. By this method, from 0.4 to 3 mg of osmium can be determined with a coefficient of variation of 3%. (auth)

7276 (CF-59-7-16) SPECTROPHOTOMETRIC DETERMINATION OF MICROGRAM QUANTITIES OF OSMIUM WITH DIPHENYLCARBAZIDE. Gerald Goldstein (Oak Ridge National Lab., Tenn.). June 2, 1959. 9p.

A method was developed for the spectrophotometric determination of 30 to 100 μg of osmium. The osmium as OsO_4 is extracted with $CHCl_3$ and diphenylcarbazide is then added to the organic extract. A blue-violet reaction product is formed, the absorbancy of which is measured at 560 mμ. A suitable reagent concentration is from 3 to 5 ml of 0.2% diphenylcarbazide in a volume of 25 ml and the preferred solvent for the reagent is ethanol. Beer's law is followed over a range of 8 to 130 μg of osmium with a coefficient of variation of about 4%. After a 2-hr color-development period the molar absorbancy index is 31,300. Attempts to achieve reproducible measurements of absorbancy in less than 2 hr were unsuccessful. A study was made of the effects of foreign elements and only Ru(VIII) was found to interfere. (auth)

7277 (CUA-NE-4) LIMITING FACTORS IN RAPID IDENTIFICATION OF SELECTED MATERIALS BY NUCLEAR TECHNIQUES. Monthly Progress Report [for] August 1960. (Catholic Univ. of America, Washington, D. C.). 6p. Contract AT(30-1)-2586.

Measurements were continued on the masking effect of high cross-section materials in a thermal neutron flux. Gadolinium, samarium, and boron compounds were tested in a 22-cm-wide chamber. Signal-to-noise ratios as high as 2.65 were obtained. This approach appears promising as a possible negative method of explosive detection. The direct determination of the 0.48-Mev γ ray as the result of neutron capture in boron looks very promising as a positive method of identification. (For preceding period see CUA-NE-3.) (auth)

7278 (GAT-T-843) THE COLORIMETRIC DETERMINATION OF CHROMIUM IN URANIUM COMPOUNDS. O. A. Vita and L. R. Mullins, Jr. (Goodyear Atomic Corp., Portsmouth, Ohio). Dec. 28, 1960. 7p. Contract AT(33-2)-1. OTS.

A method for the rapid microdetermination of chromium in uranium compounds was developed. The chromium is oxidized to the hexavalent state with permanganate and the excess permanganate is reduced with bromide. The chromium concentration is then determined by developing and measuring the color of the chromium diphenylcarbazide complex. This combination of oxidant and reductant gives this method advantages over similar methods published; i.e., excess reductant can be used without close control and a stable chromium diphenylcarbazide is formed. Quantities of from one to ten micrograms of chromium can be determined with a 10% limit of error at the 95% confidence level. (auth)

7279 (KAPL-M-GRF-1) EVALUATION OF ELECTROCHEMICAL METHOD FOR MONITORING CHLORIDE IN REACTOR COOLANTS. George R. Fountain (Knolls Atomic Power Lab., Schenectady, N. Y.). Aug. 4, 1960. 11p. Contract W-31-109-Eng-52. OTS.

The electrochemical oxidation of chloride to chlorine as a means of continuously monitoring chloride ion (1 to 10 ppm) in boiler water was studied. Evolution efficiency data, along with cell design and electrolyte conditions, were reported. Experimental results of this approach indicate that it is not a practical method for effectively monitoring chloride ion. The high cell resistance coupled with low chloride activity were the main contributors to low chlorine evolution efficiencies. (auth)

7280 (KAPL-M-JRC-3) THE DETERMINATION OF NITROGEN IN NIOBIUM AND NIOBIUM ALLOYS. J. R. Ciaranello and K. E. Combs (Knolls Atomic Power Lab., Schenectady, N. Y.). July 29, 1960. 16p. Contract W-31-109-Eng-52.

The sample is dissolved by heating with sulfuric acid and

potassium sulfate. The resulting solution is made basic with sodium hydroxide solution, and the nitrogen removed as ammonia by distillation is collected in standard acid and determined titrimetrically. The procedure was used to determine nitrogen in powders, chips, and solid pieces of niobium metal and various alloys of niobium. (auth)

7281 (TID-11354) POLAROGRAPHY IN NONAQUEOUS SOLVENTS. Annual Report. (Purdue Univ., Lafayette, Ind.). Dec. 1960. 31p. Contract AT(11-1)-163. OTS.

Unsuccessful attempts to determine gallium polarographically using sulfuric acid are described. In other work a method for the coulometric determination of water in nonaqueous solvents is described in which water was determined with acetonitrile as the nonaqueous solvent for lithium perchlorate. A study of irreversible reduction of selected nitro compounds is also discussed in which a number of nitro compounds were reduced polarographically in solvents with dielectric constants from 10.9 to 182. The nitro compounds were selected to determine if there is a correlation between structure and measured values of the half-wave potential, the heterogeneous reaction rate constant, and the transfer coefficient. Results are tabulated. (J.R.D.)

7282 (AEC-tr-4398) A NEW RAPID METHOD FOR DETERMINING THORIUM IN THE PRESENCE OF ZIRCONIUM, IRON, LANTHANUM, URANIUM, AND OTHER HEAVY METALS. R. Pribil and K. Burger. Translated by L. L. Smith from Talanta 4, No. 1, 8-12(1960). 5p.

A procedure is described for determining thorium in which thorium–complexone is decomposed by sodium sulfate, and the liberated complexone(III) is titrated with bismuth nitrate solution using xylenol orange as the indicator. The procedure may be used in the presence of large amounts of zirconium, iron, lanthanum, uranium, magnesium, and manganese, and smaller amounts of cobalt and nickel. (J.R.D.)

7283 THE DETERMINATION OF VANADIUM IN ROCKS AND METEORITES BY NEUTRON-ACTIVATION ANALYSIS. D. M. Kemp and A. A. Smales (Atomic Energy Research Establishment, Harwell, Berks, England). Anal. Chim. Acta 23, 397-410(1960) Nov.

A method for the determination of vanadium by neutron activation analysis and its application to a variety of materials is outlined. The vanadium is separated from the irradiated material by chloroform–cupferron extractions, and the activity determined by liquid counting. The only interfering elements are molybdenum and technetium and then only in samples with relatively low vanadium content. The extent of conflicting nuclear reactions was investigated. (auth)

7284 THE DETERMINATION OF SCANDIUM IN ROCKS AND METEORITES BY NEUTRON-ACTIVATION ANALYSIS. D. M. Kemp and A. A. Smales (Atomic Energy Research Establishment, Harwell, Berks, England). Anal. Chim. Acta 23, 410-18(1960) Nov.

A method for the determination of scandium in geochemical material by neutron activation analysis is outlined. A relatively simple radiochemical separation from the components of the irradiated sample was employed to provide a final source for gamma spectrometry. Sufficient "cooling" time has to be allowed to prevent interference by a short lived scandium isotope. After investigation of the magnitude of the (n,p) reaction on titanium, various rock and meteorite samples were analyzed, including the "standard" rocks, G-I and W-I. (auth)

7285 VOLTAMMETRY AT INERT ELECTRODES. I. ANALYTICAL APPLICATIONS OF BORON CARBIDE ELECTRODES. Theodore R. Mueller and Ralph N. Adams (Univ. of Kansas, Lawrence). Anal. Chim. Acta 23, 467-79 (1960) Nov.

Certain criteria for the evaluation of a working electrode for voltammetry were set forth and the B_4C electrode evaluated accordingly. Inorganic and organic ion–ion and molecule–ion oxidations and reductions as well as metal depositions were investigated using the B_4C electrode. In general, residual currents are small, half-peak potentials, are reproducible, and agree with literature data within a few millivolts. Peak currents can be measured with a precision of about 1%. The B_4C electrode appears to function as an "inert" electrode. The only system which failed to respond at B_4C was the oxidation of thallous in 0.1 N acetic acid. Present mounting methods seem to impose the most serious limitation on the applicability of B_4C electrodes. (auth)

7286 A COMPARISON OF THREE METHODS OF DETERMINING THE CONCENTRATION OF URANIUM IN SEA WATER. J. D. Wilson, R. K. Webster, G. W. C. Milner, G. A. Barnett, and A. A. Smales (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Anal. Chim. Acta 23, 505-14(1960) Dec. (In English) (AERE-R-3177)

A stable isotopic dilution method and a fluorimetric method for the measurement of the concentration of uranium in sea water are described. In both methods the uranium is extracted from the sea water into chloroform using 8-hydroxyquinoline. U^{237} is used as a tracer in the fluorimetric method. The results obtained by these two methods and by a pulse polarographic method are compared, and give a mean value of $3.3_3 \pm 0.08$ μg per l for the uranium content of samples of English Channel and Bay of Biscay water. The precision of the methods improves in the order fluorimetry, pulse polarography, isotopic dilution. (auth)

7287 METHOD FOR THE DETERMINATION OF THE CARBOXYL GROUP CONTENT OF OXYDATED CELLULOSES, USING RADIOACTIVE CATIONS. P. Bussière (Institut de Recherches sur la Catalyse, Villeurbanne, France), L. Gavet, and P. Rochas. Intern. J. Appl. Radiation and Isotopes 8, 168-71(1960) Oct. (In French)

A semimicro method for determining the carboxyl group content of oxidated cellulose was developed, by reaction with Co^{2+} and Ag^{+}. This work results in the routine semimicro titration of COOH in materials like cellulose, in the modification of the previously described uranium gravimetric method, and in a new evidence for a complex mechanism of the oxidation of cellulose by periodic acid. (auth)

7288 ACTIVATION ANALYSIS OF MANGANESE IN PULP. Ingrid Fineman and Torbjörn Westermark (Royal Inst. of Tech., Stockholm). Intern. J. Appl. Radiation and Isotopes 8, 186-91(1960) Oct. (In English)

Activation analysis by γ spectrometry of manganese in pulp was performed in the range 0.25 to 100 ppm. Test analyses show a maximum error in the manganese values of ±5%. The manganese values for pulp obtained by chemical methods show good agreement with those obtained by activation analysis in the range over about 5 ppm, while bad agreement is obtained at 1 ppm or less. (auth)

7289 LIQUID SCINTILLATION COUNTING OF TRITIATED WATER. J. F. Cameron and I. S. Boyce (Wantage Radiation Lab., Berks, Eng.). Intern. J. Appl. Radiation and Isotopes 8, 228-9(1960) Oct. (In English)

The performance of single photomultiplier and two-photomultiplier coincidence systems for counting of tritiated water were investigated for comparison. The factors contributing to the background and the effects of long-lived scintillator phosphorescence are discussed. The counting efficiencies of the two systems were determined. (D.L.C.)

7290 LIQUID SCINTILLATION COUNTING OF C^{14} PLASMA PROTEINS USING A STANDARD QUENCHING CURVE. Milton Toporek (Jefferson Medical Coll., Philadelphia). Intern. J. Appl. Radiation and Isotopes 8, 229-30 (1960) Oct. (In English)

Two standard curves were prepared for the quenching effect in the determination of C^{14} in protein with a liquid scintillation counter. For the curves, which illustrate the quenching effect of human serum protein and bovine albumin, respectively, solutions of protein in hyamine with varying amounts of DL-lysine-6-C^{14} · HCl were used. The curves should greatly simplify the problem of multiple sample counting in protein analysis for C^{14}. (D.L.C.)

7291 SIMULTANEOUS ESTIMATION OF SEVERAL RADIOACTIVE NUCLIDES. G. W. Gilbert (Christie Hospital, Manchester, Eng. and Holt Radium Inst., Manchester, Eng.). Intern. J. Appl. Radiation and Isotopes 8, 230-32 (1960) Oct. (In English)

An algebraic method is described for calculation of the activities of n radionuclides from the readings of n detectors. This method is considered in detail for Fe^{59} and P^{32} and a scintillation counter and a Geiger counter. The advantages of the method are that the simultaneous equations involved need be solved only for the calibration and that the activities of the radionuclides are measured in units of a detector reading, eliminating the necessity for determining the activities of the calibrating samples and the detector characteristics. (D.L.C.)

7292 SPECTROMETRY OF X-RAYS FROM A SOURCE EXCITED BY A RADIOACTIVE BETA EMITTER. G. Seibel (I.R.S.I.D., [France]), P. Martinelli, and H. Franco. Intern. J. Appl. Radiation and Isotopes 8, 232-4(1960) Oct. (In French)

To improve β–x fluorescence techniques, a study was made of the minimum activity of a β source which would allow spectrometry of the secondary x rays by a crystal. A Pm^{147} source was used with iron and copper targets; an ARL focusing x-ray spectrometer type XSQ was used. Calculations from the results show that copper and iron concentrations below 1% can be detected using a 100-curie Pm^{147} source. (T.R.H.)

7293 DETERMINATION OF ZIRCONIUM IN COMPLEX NICKEL ALLOYS. B. B. Bach and J. T. Francis (Mond Nickel Co., Ltd., Birmingham, Eng.). Metallurgia 62, 281-3(1960) Dec.

A spectrophotometric method, using alizarin S, was developed for the determination of zirconium in the range 0.05 to 0.2%. It is applicable to complex Ni alloys containing Mo, Ti, Ce, Cr, Co, Al, and other elements. (auth)

7294 MICRODETERMINATION OF BORON IN ORGANIC BORON COMPOUNDS. S. K. Yasuda and R. N. Rogers (Los Alamos Scientific Lab., N. Mex.). Microchem. J. 4, 155-61(1960).

The procedures described utilize the Schöniger combustion technique for the initial decomposition of a wide variety of boron compounds. Any strong acids formed during the combustion are pretitrated coulometrically in a medium containing 25 to 30% methanol and sodium nitrate as supporting electrolyte. Pelletized mannitol is added after pretitration, and the system is retitrated for boric acid. Potentially interfering acids were studied in the presence of boric acid and found to show negligible effects. Usual sample sizes ranged from 2 to 7 mg. A single determination requires 20 to 25 min. (auth)

7295 THE DETERMINATION OF GALLIUM IN ROCKS BY NEUTRON-ACTIVATION ANALYSIS. D. F. C. Morris and M. E. Chambers (Brunel Coll. of Tech., London). Talanta 5, 147-53(1960) Sept.-Oct.

Neutron-activation analysis was applied to the determination of gallium in rocks. The Harwell Pile BEPO was used as the source of neutrons, and a radiochemical procedure employing carrier chemistry was utilized to separate the induced gallium activity. Neutron-activation analyses of gallium in the standard rocks G1 and W1 are reported and compared with results obtained by other analytical methods. (auth)

7296 FERRIMETRIC DETERMINATION OF URANIUM(IV) USING RHODAMINE 6G AS FLUORESCENT INDICATOR. Seetaramaraju Sagi and G. Gopala Rao (Andhra Univ., Waltair, India). Talanta 5, 154-61(1960) Sept.-Oct.

Experimental conditions were developed for the titration of uranium(IV) with iron(III) alum solution, using Rhodamine 6G as a fluorescent indicator. The titration is best carried out at 98 to 100°C in a 2 to 3N hydrochloric acid medium under filtered ultraviolet light, using 2.0 ml of 0.05% Rhodamine 6G solution for 30 ml of the titration mixture. A slight excess of iron(III) solution quenches the greenish-yellow fluorescence of the dye through inner filter action. With the titration assembly described, it is possible to determine uranium(IV) with an accuracy of about 0.4%. This method appears to be more convenient than the potentiometric titration or the method employing potassium thiocyanate as internal indicator. Evidence is also presented to show that the reaction between uranium (IV) and iron (III) is slow at room temperature. (auth)

7297 PRECIPITATION OF METAL 8-HYDROXYQUINOLATES FROM HOMOGENEOUS SOLUTION. II. THORIUM. Kazuyoshi Takiyama, Eugene D. Salesin, and Louis Gordon (Case Inst. of Tech., Cleveland). Talanta 5, 231-7(1960) Sept.-Oct.

A comparison was made of the precipitation of thorium with 8-hydroxyquinoline by the direct method of addition of reagent and by precipitation from homogeneous solution by generation of the reagent from 8-acetoxyquinoline. The latter reagent produced a thorium precipitate with superior physical characteristics. Separation studies using cerium (III) as a diverse ion also indicated the superiority of the method using 8-acetoxyquinoline. Further studies of thorium 8-hydroxyquinolate, precipitated by either method, indicated that ignition to thorium oxide is a reliable way to conclude the determination. Methods involving weighing or brominating the 8-hydroxyquinolate generally furnished erroneous results. (auth)

7298 THE ANALYSIS OF BERYLLIUM AND BERYLLIUM OXIDE. IV. THE DETERMINATION OF COBALT. J. O. Hibbits, A. F. Rosenberg, and R. T. Williams (General Electric Co., Cincinnati). Talanta 5, 250-3(1960) Sept.-Oct.

A method is described for the determination of cobalt in beryllium or beryllium oxide by extraction of the cobalt thiocyanate complex with acetylacetone (2:4-pentanedione). The method is accurate to ±2% or 2 μg of cobalt, whichever is greater. Of the 68 elements investigated only manganese and chromium interfere in 10 mg amounts. No interference was observed when 1 g of each was removed by ion-exchange or volatilization (of chromium only) before extraction. (auth)

7299 DETERMINATION OF OXYGEN IN ZIRCONIUM BY THE PLATINUM FLUX TECHNIQUE. Ch. Venkateswarlu and Manley W. Mallett (Battelle Memorial Inst., Columbus, Ohio). Talanta 5, 283-7(1960) Sept.-Oct.

The platinum flux technique, well established for the determination of oxygen in titanium, was successfully applied to the analysis of zirconium for its oxygen content after a systematic study of the optimum experimental conditions. The extraction of oxygen was complete in 20 min in the temperature range of 1850 to 2100°C with a ratio of flux to sample of about 4.5 : 1 to 8 : 1. Statistical analysis of the results on a homogeneous sample gave a standard deviation of 0.0038 weight % and a coefficient of variance of 2.9% at a level of 0.131 weight % of oxygen in zirconium. The recommended experimental conditions are a 0.1-g sample, a 5 : 1 flux-to-sample ratio, and 20 min extraction at 1900 to 1950°C. (auth)

7300 SPECTRAL DETERMINATION OF RARE-EARTH ELEMENTS IN MINERALS AND ORES. A. N. Zaĭdel, E. N. Fafurina, P. P. Yakimova, and S. S. Yakovleva. Vestnik Leningrad. Univ. 15, No. 4, Ser. Fiz. i Khim. No. 1, 48-59(1960). (In Russian)

A method of spectral determination for rare-earth elements in minerals and ores is described. The spectral analysis of the concentrate is made after chemical separation of the total of the rare earths and extraction of cerium. The precision of the method is characterized by a mean error of ~20%. The spectrograph KSA-1 is used. The sample is exited by a-c arc burning in a CO_2 atmosphere. By the determination of the yttrium earths in some cerium minerals, the rare-earth elements are divided into two fractions by means of ion-exchange resin. The method has been tested on a great number of minerals; the results of the x ray, chromatographic, and spectral analysis are compared. (auth)

7301 NEW MICROLUMINESCENCE METHOD FOR TITRATION OF MINUTE AMOUNTS OF SUBSTANCES IN SOLUTIONS. DETERMINATION OF MINUTE AMOUNTS OF ZIRCONIUM. K. P. Stolyarov and N. N. Grigor'ev. Vestnik Leningrad. Univ. 15, No. 10, Ser. Fiz. i Khim. No. 2, 137-43(1960). (In Russian)

The principles of the microluminescence method for titration of minute amounts of substances in solutions were worked out. Luminescence microtitrometer, a new apparatus for the microluminescence titrations, is described. The microluminescence titration of zirconium is not prevented by the presence of Sn, Sb, U, Be, Ge, Al, Ti, Co, Mn, Cu, Cr, Ni, Ca, and Zn. Ce, Fe, and Th should be avoided. (auth)

7302 GRAVIMETRIC DETERMINATION OF SMALL AMOUNTS OF BERYLLIUM IN ORES AND THE PRODUCTS OF THEIR TREATMENT. L. M. Moiseeva, N. M. Kuznetsova, and I. I. Pal'shina. Zhur. Anal. Khim. 15, 561-63(1960) Sept.-Oct. (In Russian)

A gravimetric method for the determination of beryllium is described based on its precipitation as a compound with 2,2-dimethylhexanedione-3,5. Elements (Al, Ca, Ce, Fe, Nd, Ti, and UO_2^{+2}) reacting with complexone III, as well as PO_4^{3-} ions and considerable amounts of fluorine and CO_3^{2-}, do not interfere. Tin must be absent. (auth)

7303 SPECTROPHOTOMETRIC DETERMINATION OF ERBIUM AND HOLMIUM IN SOLUTIONS. I. I. Antipova-Karataeva and Yu. I. Kutsenko (Vernadskii Inst. of Geochemistry and Analytical Chemistry, Academy of Sciences, USSR, Moscow). Zhur. Anal. Khim. 15, 581-6 (1960) Sept.-Oct. (In Russian)

A quantitative method was developed for the spectrophotometric determination of erbium and halmium in aqueous and alcoholic solutions in the presence of dysprosium and other rare earths which do not have absorption bands in the region of the spectrum taken for the analysis (erbium 522.2, mμ, holmium 536.8 mμ). The determinations can be carried out within the limits of 0.05 to 1.0%. The accuracy of the method is 3 to 5%. An analysis of the fine structure of the complex absorption bands was made. It was shown that the parameters of the separate components of the complex band change differently when the aqueous medium for the absorbing ions is changed to an alcoholic one. (auth)

7304 COMPLEXOMETRIC DETERMINATION OF BISMUTH AND LEAD IN BISMUTH–LEAD ALLOYS. V. F. Luk'yanov and L. I. Sedina. Zhur. Anal. Khim. 15, 595-7 (1960) Sept.-Oct. (In Russian)

A successive complexometric determination of the components of bismuth–lead alloys in a nitric acid solution, using xylenol orange as an indicator, is described. The accuracy of the method is very high. When the weight ratio of bismuth/lead is about one, the error of a single determination of each component does not exceed 0.2 to 0.3% (rel.). It is possible to carry out 20 to 30 analyses for both the components during 6 hr. (auth)

7305 COMPLEXOMETRIC DETERMINATION OF Pu(IV) WITH ARSENAZO INDICATOR. P. N. Palei and Wan-ch'ing Chang (Vernadskii Inst. of Geochemistry and Analytical Chemistry, Moscow). Zhur. Anal. Khim. 15, 598-600(1960) Sept.-Oct. (In Russian)

A method for determining Pu(IV) is described, based on the titration with a 0.1 to 0.0005 M solution of complexone(III) in acid media (0.1 to 0.2 N HNO_3 or HCl), using arsenazo(I) as an indicator. La^{3+}, UO_2^{2+}, Cr^{3+}, Pb^{2+}, and Ni^{2+} do not interfere. Fe^{3+} must not exceed 3 to 4% of plutonium content. (auth)

7306 DETERMINATION OF FLUORINE IN ZIRCONIUM METAL USING THE DISCHARGE IN A HOLLOW CATHODE. Yu. I. Korovin. Zhur. Anal. Khim. 15, 618-22 (1960) Sept.-Oct. (In Russian)

The possibility of the analytical use of secondary chemical reactions taking place in the special conditions of the high-temperature discharge in a hollow cathode was shown using as an example the determination of small amounts of fluorine in zirconium metal. A highly sensitive spectrographic method for the determination of fluorine in zirconium metal was developed. (auth)

7307 ON THE MASS-SPECTROMETRIC ANALYSIS OF THE ISOTOPIC COMPOSITION OF ELEMENTARY BORON. Yu. A. Zonov (State Institute of Applied Chemistry, Leningrad). Zhur. Anal. Khim. 15, 643-5(1960) Sept.-Oct. (In Russian)

The method of evaporation from a ribbon evaporator was used in the mass-spectrometric isotopic analysis of elementary boron. The isotopic composition of boron with natural and altered ratios of the isotopes was measured. The results were checked by comparing with the measurements of the isotopic composition of boron in the initial product (H_3BO_3). The process of evaporation of boron was studied. It was found that in the process of evaporation the normal fractionating of boron isotopes occurs. The influence of the fractionating effects of the accuracy of determination of the isotopic composition of boron was studied. (auth)

7308 METHODS OF RADIOCHEMICAL ANALYSIS. Report of a Joint WHO/FAO Expert Committee. World

Health Organization Technical Report Series, No. 173. Geneva, World Health Organization, 1959. 116p. $1.00.

Methods are presented for the radiochemical analysis of air and other gases; drinking water; surface water; sea water; waste solutions; sewage; aquatic organisms; bottom mud samples; fresh and dried milk; vegetation; and samples of human origin such as urine, breath, feces, and blood. Procedures and equipment are described for the determination of tritium, strontium isotopes, iodine isotopes, cesium isotopes, polonium, thorium, uranium, and plutonium. (C.H.)

7309 ANALYSIS OF GASES. Peter James Allsopp (to United Kingdom Atomic Energy Authority). British Patent 856,628. Dec. 21, 1960.

A galvanic cell for oxygen determination in gases in which oxygen is absorbed at the cathode is designed with a spiral silver cathode so that a long water line (contact between cathode, gas, and electrolyte) results, speeding up the cell response to variations of oxygen concentration in a gas stream passing through the cell. A calibration vessel is provided which generates electrolytically a known amount of oxygen for cell calibration. A drawing of the cell is included. (D.L.C.)

7310 METHOD OF TESTING THERMAL NEUTRON FISSIONABLE MATERIAL FOR PURITY. E. Fermi and H. L. Anderson (to U. S. Atomic Energy Commission). U. S. Patent 2,969,307. Jan. 24, 1961.

A process is given for determining the neutronic purity of fissionable material by the so-called shotgun test. The effect of a standard neutron absorber of known characteristics and amounts on a neutronic field also of known characteristics is measured and compared with the effect which the impurities derived from a known quantity of fissionable material has on the same neutronic field. The two readings are then made the basis of calculation from which the amount of impurities can be computed.

General Inorganic and Physical Chemistry

7311 (AAEC/E-42) DISSOLUTION OF SINTERED THORIA. M. S. Farrell (Australia. Atomic Energy Commission Research Establishment, Lucas Heights, New South Wales). Nov. 1959. 24p.

Thoria, prepared by calcining thorium oxalate and compacted and sintered, became increasingly more difficult to dissolve in HNO_3–HF mixtures as the sintering temperature was increased. The temperature of calcination of the oxalate is an important factor. Low calcination temperatures produced a more reactive thoria with a greater surface area. This thoria sintered more readily, producing denser compacts that had a smaller BET surface area and were more difficult to dissolve. Thoria produced by calcination at 600°C showed "mottling" when sintered at 1700°C. These dark-colored mottles dissolved much more slowly than the white matrix in which they were embedded. No material other than thoria was detected in an x-ray analysis of the mottled material. No extra lines or deformations were visible, and although interstitial carbon was suspected, no evidence for this was obtained. (auth)

7312 (AERE-R-3515) A SURVEY OF THE PLUTONIUM SPECTRA IN THE 7,000-10,000 A REGION. L. Bovey, M. C. J. Barker, and A. Ridgeley (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Nov. 1960. 13p.

A list of wave lengths for the stronger lines in the 7000 to 10,000 A region of the plutonium spectrum emitted from a microwave-excited electrodeless discharge is presented. (auth)

7313 (CF-59-2-98) SUMMARY OF RUNS D-77 THROUGH D-93. RATE OF OXIDATION OF CHROMIUM(III) IN DILUTE URANYL SULFATE SOLUTION IN THE PRESENCE OF RUTHENIUM. E. S. Snavely, R. S. Greeley, and S. R. Buxton (Oak Ridge National Lab., Tenn.). Feb. 27, 1959. 14p.

The rate of oxidation of chromium(III) to chromium(VI), catalyzed by ruthenium, was determined at various temperatures and oxygen concentrations. The rate at 300°C was too rapid for measurement by aliquot sampling. In the temperature range of 225 to 275°C, oxidation was rapid and the rate increased with oxygen concentration. A linear dependence of initial oxidation rate on the reciprocal of chromium(VI) concentration suggested that a rate-controlling step in the reaction mechanism may be desorption of chromium(VI) from the ruthenium catalyst. The activation energy calculated for the reaction is 19 kcal/mole. (auth)

7314 (CF-59-3-112) SPECTROPHOTOMETRY OF MOLTEN FLUORIDE SALTS. Status Report. J. C. White (Oak Ridge National Lab., Tenn.). Mar. 25, 1959. 16p.

Progress made in the field of spectrophotometry of molten fluoride salts is summarized. The high-temperature cell assembly designed and fabricated for use in this work is described, as well as the various types of sample containers used. Spectra of nickel fluoride, cobalt fluoride, chromic fluoride, and uranium tetrafluoride in LiF–NaF–KF (46.5–11.5–42 mole %) are presented. (auth)

7315 (CF-60-9-5) PRECIPITATION OF CRYSTALLINE URANIUM AND THORIUM PEROXIDE: APPLICATIONS TO FUEL-ELEMENT OXIDES AND PURIFICATIONS. H. B. Whetsel and O. C. Dean (Oak Ridge National Lab., Tenn.). Sept. 21, 1960. 17p.

Departures from the usual precipitation method produced crystalline uranium peroxide in several forms. Three types of segregated needles were used in the preparation of three pellets for pellet-type elements. Densities of the pellets ranged from 93 to 97% of theoretical, depending on conditions of precipitation. Uranium peroxide was also precipitated with good yield at a low pH from sulfate solutions. The departures are the use of acidified hydrogen peroxide reagent, development of nuclei, achieving a pH sufficiently low (usually less than 1, and preferably between 0.2 and 0.8 for most work) for the first crop of crystals (about 95%), and controlling the initial pH. Alternatively, precipitation from homogeneous solution can be achieved by use of altered conditions. Single precipitations from ore concentrates provided good decontamination factors for iron, molybdenum, and sodium. Filterability ranged from fast to slow, depending on ore constituents. Iron, which can interfere with peroxide precipitations, can be rejected in substantial proportions from some ore concentrates by use of a quantity of nitric acid that stoichiometrically matches the uranium content. Results for uranium recovery and iron rejection ranged from good to fair, depending on the ore. Thorium peroxide was precipitated in crystalline form from homogeneous solution by an adaptation of the method for uranium. Recovery was almost 98%, and the crystals were about 0.5 μ long. (auth)

7316 (IS-178) LOW-COST BRIDGMAN-TYPE SINGLE-CRYSTAL GROWING APPARATUS. Edwin H.

Olson (Ames Lab., Ames, Iowa). Aug. 1960. 50p. Contract W-7405-eng-82.

The design, operation, and results obtained using a low-cost, Bridgman type, single-crystal growing apparatus are presented. The discussion is divided into sections covering the crystallizing crucible, furnace, and sample lowering assemblies along with recommended changes that it was felt would improve the operation. Single crystals of zinc, lead, tin and silver chloride were successfully grown. Sizes of the single crystals varied from $\frac{3}{8}$ to $\frac{3}{4}$ in. in diameter and were grown in lengths up to $3\frac{1}{2}$ in. The crystallizing crucibles used were quartz and graphite, and all had 50° conical nucleating tips. Tapered walls on graphite crucibles greatly facilitated the removal of the single crystals from the crucibles. The equipment was found to be simple to operate and the conditions were readily reproducible. The low cost of approximately $500.00 should make it of interest to persons desiring to grow their own single crystals of low melting point materials. Dimensioned drawings are included so the equipment can be duplicated. (auth)

7317 (NAA-SR-5094) THE MERCURY–MERCURIC CHLORIDE SYSTEM. S. J. Yosim and S. W. Mayer (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). June 1, 1960. 13p. Contract AT-11-1-GEN-8.

A phase-equilibrium study of the mercury–mercuric chloride system was carried out by thermal analysis and the visual method. The salt-rich eutectic composition is 4.9 mole % Hg and occurs at 273°C. The syntectic line at 525°C extends from 48 to 94 mole % Hg. The solubility of Hg_2Cl_2 in mercury increases to 6.8 mole % at 560°C. Freezing-point depression measurements for $HgCl_2$ suggest that mercury dissolves either as atoms or as Hg_2Cl_2 molecules formed by the reaction of mercury with $HgCl_2$. A thermodynamic analysis of the liquid-solid equilibrium curve between the salt-rich eutectic and the base of the miscibility gap suggests that solution of mercury as atoms is not likely in this region. (auth)

7318 (NAA-SR-Memo-5479) GAS DIFFUSION INTO A BUBBLE OF FIXED RADIUS. C. Warner, III (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). July 15, 1960. 5p. OTS.

The problem of radiolytic gas diffusion into a bubble of fixed radius is solved. A constant source of radiolytic gas is assumed. The concentration of gas at the bubble surface is related to the pressure within the bubble by Henry's constant. (W.L.H.)

7319 (NRL-5555) A THERMODYNAMIC ANALYSIS OF SOLUBILITY IN LIQUID METAL SYSTEMS. J. L. White (Naval Research Lab., Washington, D. C.). Aug. 11, 1960. 25p.

Binary liquid-metal solubility equilibria of the type A (in solid or liquid phase) $\rightleftharpoons$ A (in liquid B) are analyzed in terms of the fundamental thermodynamic solution parameters $\Delta\bar{H}^{\infty}_{A(\ell)}$ and $\Delta\bar{S}^{xs,\infty}_{A(\ell)}$, the heat and entropy, respectively, of solution of the liquid solute at infinite dilution in the liquid solvent. A general method for the treatment of equilibrium solubility data is developed and is termed the Σ'-function method, in view of its similarity to the standard Σ-function method for the treatment of vapor-pressure data. By the assumption of subregular behavior of the liquid-metal solution, the Σ'-function method is applicable to moderately concentrated solutions. Consideration is given to details of the application of the method to the three general states of the solute phase: pure solute A, terminal solution of B in A, and intermetallic compound A_xB_{1-x}. The Σ'-function method is applied to five binary systems for which data are available in the literature: Mg-Fe, Pb-Ni, Bi-Be, Pb-Zn, and Pb-Cu. The results are in close agreement with the results published in the literature. (auth)

7320 (NYO-9514) SYNTHESIS OF SEMICONDUCTOR MATERIALS BY RADIATION INDUCED REACTIONS. Quarterly Status Report No. 6 [for] Period Covered August 1, 1960–October 31, 1960. Kalman Held and Richard Goldman (Technical Research Group, New York). 4p. Contract AT(30-1)-2392. (TRG-132).

The preparation of silane and filling of sample containers for Co^{60} and in-pile irradiation studies and for thermal decomposition studies are reported. The construction of various heaters to be employed for the thermal decomposition of high-temperature irradiation studies is described. (W.L.H.)

7321 (TID-6766) FOAM SEPARATION. Quarterly Progress Report No. 1 [for] July 1, 1960 to September 30, 1960. (Radiation Applications Inc., Long Island City, N. Y.). 17p. For Oak Ridge National Lab., Subcontract 2024. OTS.

The effect of gas rate on the single stage γ/c value was studied. It was found that this parameter is essentially independent of the gas flow rate in the range 30 to 100 ml/min. A screening program for commercially available surfactants was initiated. The agents screened thus far were proved ineffective for cesium, while several show promise for strontium separation. (auth)

7322 (TID-6796) EFFECT OF OXIDE ADDITIONS ON THE CATALYTIC RECOMBINATION OF H_2, O_2 IN THORIA SLURRIES. Technical Report No. VIII. Ralph M. Horton, David A. Reese, Russell A. Schalow, and Milton E. Wadsworth (Utah. Univ., Salt Lake City. Inst. of Metals and Explosives Research). Aug. 25, 1960. 29p. For Oak Ridge National Lab. Contract W-7405-eng-26, Subcontract No. 1975.

A method of incorporating impurity elements as oxides in a thorium oxide lattice is described. The influence of these impurity elements on the catalytic recombination of hydrogen and oxygen is discussed. A method of increasing the catalytic activity by adsorbing platinum on thoria particles is given. Comparison of the rates obtained in this report is made with data obtained by other investigators. (auth)

7323 (TID-6797) CATALYTIC COMBINATION OF HYDROGEN AND OXYGEN IN THORIA SLURRIES. [PART] III. Technical Report No. IX. Ralph M. Horton, Frederic H. Megerth, David A. Reese, and Milton E. Wadsworth (Utah. Univ., Salt Lake City. Inst. of Metals and Explosives Research). Sept. 15, 1960. 15p. For Oak Ridge National Lab. Contract W-7405-eng-26, Subcontract No. 1075.

Tests were conducted to delineate the degree of effectiveness in maintaining catalytic activity of large and small additions of colloidal silica directly to the slurry mixture made with platinized thoria. The small amounts of silica were the most effective in maintaining catalytic activity although this catalyst also decreased in activity with repeated runs to an unacceptable degree. Tests were made to ascertain whether the addition of silica to the thoria surface before platinizing might improve the catalyst life. A refluxing technique using both sodium silicate and colloidal silica was employed. The results were comparable with those reported earlier for a similar technique using silicic acid. The catalyst life was improved compared to nonsilicated thoria but was still not as long as desired.

A series of experiments was run using a palladium sol catalyst. This catalyst had fairly good activity although the results may not be quantitatively compared with those obtained at ORNL since an oxygen pretreatment was not used. The catalytic rate decreased with repeated runs although not as much as previously tested catalysts. This catalyst was much more active if the hydrogen was added to the autoclave before the oxygen than vice versa. It was also observed that when the gases did not react completely, the partial pressure of hydrogen in the unreacted gas was about 130 psi. (auth)

7324 (TID-6869) A PLATINIC ACID–THORIUM HYDROXIDE CATALYST FOR HYDROGEN–OXYGEN RECOMBINATION. Technical Report No. X. C. Keith Hanson, Ralph M. Horton, David A. Reese, and Milton E. Wadsworth (Utah. Univ., Salt Lake City. Inst. of Metals and Explosives Research). Oct. 5, 1960. 11p. For [Oak Ridge National Lab.]. Contract W-7405-eng-26, Subcontract No. 1075.

A new catalyst, prepared by combining platinic acid with thorium hydroxide, is described. Preliminary results indicate high reactivity and stability in both excess hydrogen or oxygen. (W.L.H.)

7325 (TID-11276) SURFACE CHEMISTRY PHENOMENA. Progress Report. (Utah. Univ., Salt Lake City. Inst. for the Study of Rate Processes). Oct. 31, 1960. 68p. Project No. 1. Contract AT(11-1)-82.

Results of a surface chemistry research project on corrosion of zirconium in a molten salt mixture of potassium nitrate with sodium nitrate and nitrite are reported. The zirconium corrosion rate increased with temperature as did the amount of zirconium soluble in the melt. An equilibrium point at which no further dissolution of zirconium was observed at the test temperatures. In platinum electrode kinetics and strain electrochemistry in acids, research was devoted to gaining information concerning the permeability of smooth platinum to electrolytic hydrogen, and determining the fundamental reactions taking place at the metal-solution interface of a smooth platinum electrode in acid solutions. A model was constructed from experimental data which supports the idea that smooth platinum is permeable to electrolytic hydrogen and that hydrogen and oxygen reactions are the most important ones occurring at the solution-metal interface. In research on transient electrode potentials of mercury, nickel, zinc, and lead, techniques are used in which metals are plastically deformed at a constant rate in the reaction cell with the result that the oxide film is ruptured and clean surfaces are generated at a constant rate. These surfaces react with their environment, producing a measurable potential. Data on decay potentials are presented graphically. In research on steady-state potentials and potential-time curves related to the unsteady states of nickel in electrolytes prior to plastic straining, activities were centered around design of an improved test cell and use of the cell to determine the effects of oxygen in solution. In other work, the design and operation of a new distillation unit to produce water that is free from ionic and organic impurities as well as dissolved gases are described. (J.R.D.)

7326 (TID-11418) STUDIES OF RATES AND EQUILIBRIA IN INORGANIC REACTIONS IN SOLUTION. Technical Progress Report. Edward L. King (Wisconsin. Univ., Madison). Dec. 1960. 6p. Project No. 3. Contract AT(11-1)-64. OTS.

The reactions of cis and trans difluoro-chromium(III) and chromium(II), the thermodynamics of thallium(III) chloride complex ion formation, the rate of iron(II) and chromium(VI) reactions in acidic solution, and the reaction of chromium(III) azide complex and chromium(II) were studied. (W.L.H.)

7327 (AEC-tr-4357) STATE DIAGRAMS OF BINARY SALT SYSTEMS. 5. $TiCl_3$–NaCl, $TiCl_3$–KCl, $TiCl_3$–RbCl, $TiCl_3$–CsCl. B. F. Markov and R. V. Chernov. Translated by Lydia Venters (Argonne National Lab.) from Ukrain. Khim. Zhur. 25, 279-84(1959). 9p.

A thermal analysis was carried out on $TiCl_3$–NaCl, $TiCl_3$–KCl, $TiCl_3$–RbCl, and $TiCl_3$–CsCl. One eutectic was detected in the first. Congruently melting compounds were found in the other three with general formulas $MTiCl_4$ and M_3TiCl_6. In these fused salts, titanium is in the form of complex ions. (T.R.H.)

7328 (CEA-tr-R-1046) DÉTERMINATION DE LA SOLUBILITÉ DE L'HYDROXYDE DE POLONIUM. (Determination of the Solubility of Polonium Hydroxide). D. M. Ziv and I. A. Efros. Translated into French from Radiokhimiya 1, 290-4(1959). 12p.

This was previously abstracted and appears in NSA, Volume 14, as Abstract No. 5139.

7329 (NP-tr-534) THE VAPOUR PRESSURE OF T_2O. M. M. Popov and F. P. Tazetdinov. Translated from Atomnaya Energ. 8, 420-4(1960). 8p. JCL or LC.

A method is described for measuring the vapor pressure of samples of tritiated water containing high percentages of H^3 (83.4 and 98.1 mole % T_2O) in the temperature range 12 to 95°C. On account of the pressure of gaseous radiolysis products of water, the measurements were carried out by a static method for two values of the apparatus volume. It is found that the boiling points of HTO and T_2O are 100.8 and 101.6°C, respectively, the latent heats of evaporation at these temperatures are 9.9 and 10.1 kg cal/mole and the standard entropies 19.3 and 19.0 ee, respectively. (auth)

7330 HYDROGEN BONDING IN ZIRCONIUM SULFATE TETRAHYDRATE. David H. Templeton (Univ. of Calif., Berkeley). Acta Cryst. 13, 684(1960) Aug. (UCRL-9051)

A possible assignment suggested for the structure of $Zr(SO_4)_2 \cdot 4\ H_2O$, by Singer and Cromer involves water oxygen (O_3) with four close neighbors each in the same square antiprism, O_2 at 2.53, 2.62, and 2.86 A and O_3 at 2.72 A, and three other neighbors, O_1 at 2.69, 2.75, and 2.93 A. In this assignment, the hydrogen bonds are assigned to the 2.69 and 2.75 A distances; the angle between these two bonds is 88°, and the bisector of this angle is 180° from the line from O_3 to zirconium. (D.L.C.)

7331 THE THERMAL DECOMPOSITION OF THE URANYL AND SODIUM URANYL CARBONATES. L. G. Stonhill (Eldorado Mining and Refining Ltd.. Ottawa, Ont.). Anal. Chim. Acta 23, 423-7(1960) Nov.

The thermal decomposition of the sodium uranyl carbonates and the binary uranyl carbonate was investigated by differential thermal analysis and thermogravimetry. Uranyl carbonate decomposes in one stage only: $UO_2CO_3 = UO_3 + CO_2$. Evidence was obtained for a two-stage thermal decomposition of the sodium uranyl carbonates. (auth)

7332 HEAT OF FORMATION OF $PuBe_{13}$. V. V. Akhachinskiĭ and L. M. Kopytin. Atomnaya Energ. 9, 504-5(1960) Dec. (In Russian)

The heat of formation of $PuBe_{13}$ was determined by measuring the heat of dissolution in 19% hydrochloric acid in a microcalorimeter. The data on beryllium, plutonium, and

their alloys, calculated according to the Hess heat of formation law, show for $PuBe_{13}$—ΔH^0_{298} equal to 35.7 ± 3.4 kcal/mole. (R.V.J.)

7333 THE REACTIONS OF CHROMIUM(II) AND THE ISOMERIC DIFLUOROCHROMIUM(III) IONS. Yuan-tsan Chia and Edward L. King (Univ. of Wisconsin, Madison). Discussions Faraday Soc. No. 29, 109-12(1960).

The transition state for the electron-transfer reaction of cis-difluorotetra-aquochromium(III) ion with chromium (II) ion which involves two fluoride ions acting as bridging groups is not detected. Reaction by this pathway is much slower than by the pathway involving a single fluoride ion acting as the bridging group. The values of $\Delta H^{\ddagger}$ and $\Delta S^{\ddagger}$ for the reactions of chromium(II) ion with cis-difluorotetra-aquochromium(III) ion and with monofluoropenta-aquochromium(III) ion are very similar. (auth)

7334 TRANSITION OF ELECTRONIC CONDUCTION INTO IONIC CONDUCTION AS RELATED TO THE COMPOSITION OF SOLID OXIDE SOLUTIONS. S. F. Pal'guev, S. V. Karpachev, A. D. Neuĭmin, and Z. S. Volchenkova (Inst. of Electrochemistry, Ural Branch, Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R. 134, 1138-41(1960) Oct. 11. (In Russian)

The influence of calcium oxide on the electro-conductivity of mixed oxides (Ce, Zr/O_2) was studied, and the character of conductivity was determined for several specimens, (0.75 CeO_2 · 0.25 ZrO_2) + CaO at 500 to 1000°C. The composition 0.75 CeO_2 · 0.25 ZrO_2 was considered as a single component with known maximum conductivity. The tests show that with small admixtures of calcium oxide, the ionic conductivity increases but the general conductivity decreases. Calcium oxide additions to zirconium dioxide and cerium dioxide separately induce an increase only in the general conductivity. Moreover, the higher the content of CaO in solid solutions, the larger the ionic conductivity. In the triple solution CeO_2–ZrO_2–CaO, oxygen ions are carriers of the ionic conductivity component. The electronic conductivity in solid solutions of CeO_2–ZrO_2 appears with the partial reduction of Ce^{4+} to Ce^{3+}. Measurements on solid electrolytes in contact with gases with high partial oxygen pressures (1.0 to 0.2 atm) show that with 20 to 40 mole % CaO the ionic conductivity is ~100%, while with small oxygen pressure (10^{-7} to 10^{-25} atm) electronic conductivity prevails. The ionic conductivity in the examined material reaches a maximum at 750°C. (R.V.J.)

7335 CERTAIN PHYSICAL PROPERTIES OF FERROMAGNETIC LEAD FERRONIOBATE AND FERROTANTALATE. V. A. Isupov, A. I. Agranovskaya, and N. P. Khuchua. Izvest. Akad. Nauk S.S.S.R., Ser. Fiz. 24, 1271-4(1960) Oct. (In Russian)

Study of the properties of lead ferroniobate and ferrotantalate is of great theoretical interest because bi- and trivalent ions make possible the redistribution of spatial arrangements in the O octahedron and allow the investigation of the effect of various ionic parameters, such as size, electronic polarizability, etc. Both of these compounds have a higher iron content than $BaTiO_3$. They were prepared using c.p. Fe_2O_3, PbO, and Nb_2O_5 and Ta_2O_5, respectively, by a high-temperature method, resulting in the formation of relatively dense Pb_2FeNbO_6 and Pb_2FeTaO_6, with a porosity ranging from 8 to 10%. The structure of both materials was found to be similar to that of perovskite. X-ray diffraction methods showed that the parameter of the cubic lattices was 4.00 A. Both materials had definite ferroelectric properties. Their spontaneous polarization was lower than that of $BaTiO_3$. The lead ferroniobate had a piezoelectric modulus similar to that of $BaTiO_3$. It also possessed a high magnetic susceptibility. Both compounds had a large electrostrictive effect, but, unlike $BaTiO_3$, they do not have a low-temperature transition point, at least not down to –190°C. (TTT)

7336 ELECTRIC PROPERTIES OF CERTAIN SOLID SOLUTIONS OF NIOBATES AND TANTALATES OF BIVALENT METALS. P. S. Mikhaĭlov and B. A. Rotenberg. Izvest. Akad. Nauk S.S.S.R., Ser. Fiz. 24, 1282-4(1960) Oct. (In Russian)

Three-component systems of lead and alkaline-earth niobates were prepared, replacing partially the niobium by tantalum, in order to establish the influence of the replacement on the ferroelectric properties of the system. The general composition of the solid solutions is given by the formulas: $(Pb_{0.5}Ba_{0.1}Sr_{0.4})$ $(Nb_{1-x}Ta_x)_2O_6$ and $(Pb_{0.6}Ba_{0.2}Ca_{0.2})$ $(Nb_{1-x}Ta_x)_2O_6$, using Ba, Ca, and Sr carbonates, PbO, and Nb_2O_5 and Ta_2O_5 as raw materials. The usual ceramic preparative methods were employed, firing the compounds containing large amounts of tantalum under an inert atmosphere. X-ray diffraction studies of the systems showed that their structure is similar to that of the orthorhombic lead niobate. In view of this and of the near-identity of the ionic diameters of Nb^{5+} and of Ta^{5+}, it could not be established with certainty whether the systems were solid solutions or heterogeneous mixtures. No hysteresis loops were observed at liquid nitrogen temperatures with materials having relaxation properties, not even with systems with an x value ≤0.3 which presented such loops at room temperature, which may be explained by the increase of the coercive field at low temperatures. The replacement of niobium by tantalum led first to a weakening of the ferroelectric properties, followed by emergence of relaxation properties. (TTT)

7337 THE SELF-INDUCED EXCHANGE OF TRITIUM GAS WITH METHANE. Thomas H. Pratt and Richard Wolfgang (Yale Univ., New Haven). J. Am. Chem. Soc. 83, 10-17(1961) Jan. 5.

The exchange of H^3 atoms between T_2 gas and methane as induced by radioactive decay of the H^3 was studied. Kinetic data indicate the existence of three distinct mechanisms: (1) decay of H^3 in T_2 yields HeT^+ which reacts rapidly with CH_4 to yield excited CH_4T^+. This species reacts further to yield CH_3T. The mechanism shows the required first-order dependence of T_2 pressure and is insensitive to scavenging by xenon. (2) The H^3 β radiation causes formation of several species with lifetimes limited by recombination. One of these, probably CH_5^+, undergoes reaction with T_2 leading to CH_3T. This mechanism gives an observed $^3/_2$ power dependence on T_2 pressure and is sensitive to ion scavengers. (3) A small square power term in the kinetics probably arises from the β radiolysis of the T_2 itself. The type of mechanisms postulated may be applied to the exchange of H^3 with other substances. However, the present dearth of information on elementary ion-molecule processes makes it difficult to establish detailed, unique mechanisms for more complex systems. (auth)

7338 ISOTOPE EFFECTS IN DEUTERIUM OXIDE SOLUTION. I. ACID-BASE EQUILIBRIA. C. A. Bunton and V. J. Shiner, Jr. (Indiana Univ., Bloomington, Ind. and Univ. Coll., London). J. Am. Chem. Soc. 83, 42-7 (1961) Jan. 5.

It is suggested that the deuterium oxide-solvent isotope effect on aqueous acid dissociation constants arises principally from changes in zero-point energy associated in

turn principally with changes in hydrogen bonding strength and number of dissociation. These considerations led to a simple quantitative method of estimating the isotope effect on acid-base equlibrium constants; this shows good agreement with experiment. (auth)

7339 CYANIDE CARBON ISOTOPE FRACTIONATION IN THE REACTION OF CYANIDE ION AND METHYL IODIDE. CARBON ISOTOPE EFFECT IN THE HYDROLYSIS OF METHYL IODIDE. K. R. Lynn and Peter E. Yankwich (Univ. of Illinois, Urbana). J. Am. Chem. Soc. 83, 53-7(1961) Jan. 5.

The C^{13} isotope effects for isotopy at the cyanide carbon in the cyanization of methyl iodide and that in the hydrolysis of methyl iodide were investigated for water solvent at 11.4 to 58°. The results for hydrolysis are somewhat smaller than expected from the single value reported by Bender and Hoeg for the C^{14} effect, being at the 3.5% level; the cyanide carbon isotope effect in the cyanization is only about 1.0%. The results are examined in terms of a Bigeleisen–Wolfsberg–Slater three-particle model for the reacting system, special attention being paid to the choice between "atomic" and "molecular fragment" masses in the calculation of the temperature-independent factor in the isotopic rate-constant ratios. The data do not permit a clear choice to be made between these bases for the computations. (auth)

7340 STABILIZATION OF THE CADMIUM(I) OXIDATION STATE. THE SYSTEM $Cd-Cd_2^{+2}(AlCl_4)_2-Cd^{2}(AlCl_4)_2$. John D. Corbett, William J. Burkhard, and Leonard F. Druding (Ames Lab., Ames, Iowa). J. Am. Chem. Soc. 83, 76-80(1961) Jan. 5.

The effects of added salts on the degree of solubility of cadmium metal in the molten cadmium(II) halides are reinterpreted in terms of acid-base reactions between the added halides and a solution of Cd_2X_2 in CdX_2. At 335°, melts containing 67, 57, and 31 mole %. Cd_2^{+2} result when $CdCl_2$, $CdBr_2$, and CdI_2 are reduced in the presence of two moles of the respective aluminum trihalides per mole of the dihalide. The presence of stable cadmium(I) salts in the diamagnetic white-to-yellow products obtained on solidification of these melts is confirmed by the $Cd-Cd_2(AlCl_4)_2-Cd(AlCl_4)_2$ phase diagram and by the isolation of $Cd_2(AlCl_4)_2$. This salt decomposes to metal and a melt containing 65% Cd_2^{+2} at 227° and disproportionates in all solvents much more basic than benzene. In the melts the increased stability of the cadmium(I) oxidation state, when X^- is replaced by the larger and less basic AlX_4^-, is considered to result from the decrease in the interaction of the more acidic cation, Cd^{+2}, with the anion, and, in the solid, from the related decrease in the difference in lattice energies of the salts in the two oxidation states. The contrast between the light green color of the reduced tetrachloroaluminate melts and the opacity of those containing chloride ion is discussed. (auth)

7341 THE EFFECTS OF DEUTERIUM SUBSTITUTION ON THE RATES OF ORGANIC REACTIONS. VI. SECONDARY ISOTOPE EFFECTS ON THE SOLVOLYSIS RATES OF γ-METHYL SUBSTITUTED t-ALKYL CHLORIDES. V. J. Shiner, Jr. (Indiana Univ., Bloomington). J. Am. Chem. Soc. 83, 240-3(1961) Jan. 5.

Deuterium substitution β to the chlorine of tertiary alkyl chlorides has previously been observed to have a marked decelerating influence on the rate of solvolysis of the alkyl chloride. A continuation is given of the study of these secondary isotope rate effects with particular reference to the influence of alkyl substitution on them. The 3,3-dideuterio analogs of all and the 1,1,1-trideuterio analogs of all but the second member of the following series of compounds were synthesized, and their solvolysis rates in "80%" aqueous alcohol at 25° measured: 2-chloro-2-methylbutane, 2-chloro-2-methylpentane, 2-chloro-2,4-dimethylpentane, and 2-chloro-2,4,4-trimethylpentane. The secondary isotope rate effects of the 1-deuterio substitution do not show large variations in the series while the effects of 3-deuterio substitution are about the same for all but the last member of the series where only a small effect is evident. This result is thought to be caused by steric inhibition of hyperconjugation in the neopentyl group of the last compound. The rate constants were calculated by a statistical method programmed for an electronic computer. (auth)

7342 DIFFUSION IN A LIQUID INDIUM–TIN ALLOY AT THE EUTECTIC CONCENTRATION. A. Paoletti (Comitato Nazionale per le Ricerche Nucleari, Rome) and M. Vicentini. J. Appl. Phys. 32, 22-4(1961) Jan.

Self diffusion coefficients for the two tracers In^{114} and Sn^{113} in the liquid alloy indium–tin at the eutectic composition were measured as a function of temperature at 200 to 450°C. The customary Arrhenius equation is used to describe the experimental results. For indium as a tracer $D = (42.5 \pm 5.7)\ 10^{-5} \exp(-2771 \pm 158/RT)\ cm^2/sec$, and for tin $D = (11.7 \pm 1.7)\ 10^{-5} \exp(-1380 \pm 156/RT)\ cm^2/sec$. It is possible that the large difference between the two activation energies could be associated with properties of the eutectic composition. (auth)

7343 SOLUBILITY OF ZINC SULFIDE IN MOLTEN HALIDE SALTS. Gleb Gashurov and Albert K. Levine (Gen. Telephone and Electronics Labs., Inc., Bayside, N. Y.). J. Chem. Eng. Data 5, 517-18(1960) Oct.

The solubility of ZnS in molten $ZnCl_2$ was determined. Results are also tabulated for the solubility of ZnS in molten NaCl, KCl, $ZnBr_2$, ZnI_2, and mixtures of $ZnCl_2$ with KCl and NaCl, with two values in $ZnCl_2$ at 580 and 730°C for comparison. The solubility of ZnS decreases as the nature of the solvent progresses from a more ionic to a more covalent one. In the strongly ionic solvents, NaCl and KCl, the solubility is considerably smaller than in $ZnCl_2$. These results suggested that the solubility of ZnS might be enhanced in solvents having a bonding type intermediate between those of alkali halides and $ZnCl_2$. (B.O.G.)

7344 SOLUBILITIES OF LITHIUM CHLORIDE AND LITHIUM THIOCYANATE AT LOW TEMPERATURES. F. A. Schimmel (Union Carbide Nuclear Co., Y-12 Plant, Oak Ridge, Tenn.). J. Chem. Eng. Data 5, 519-20(1960) Oct.

The lithium chloride used in these measurements was purified by several recrystallizations from water, until it was free from sulfate and contained <0.001% of calcium plus barium. The systems investigated were $LiCl-H_2O$, $LiCl-HCl-H_2O$, and $LiSCN-H_2O$. The eutectic temperature for $LiCl-H_2O$ was found by thermal analysis to be -84 ± 0.5°C. The solubility determinations for $LiCl-HCl-H_2O$ were made at 25°C and comparison was made for $NaCl-HCl-H_2O$ values at 30°C. In analogy of the $LiSCN-H_2O$ system to LiCl, it can be said that in the temperature range of +43.3 to +1°C, the solid phase is the dihydrate. The trihydrate exists from +1 to –56°C; and from –56 to –92°C. A higher hydrate, probably the pentahydrate, is the stable solid phase. (B.O.G.)

7345 SYNTHETIC INORGANIC ION EXCHANGERS. ADSORPTION OF ZIRCON–SILICA GELS. D. Naumann (Zentralinstitut für Kernphysik, Rossendorf, Ger.). Kernenergie 3, 984-8(1960) Oct.-Nov. (In German)

After a literature search on the development and uses

of synthetic inorganic ion exchangers, the exchange behavior of mixed gels of ZrO_2 and SiO_2 is examined. With increasing mole ratios $SiO_2:ZrO_2$, a capacity maximum is passed through. An increase in acidity permits phosphate treatment. (tr-auth)

7346 NUCLEAR SPIN RELAXATION AND MOLECULAR DIFFUSION IN LIQUID HYDROGEN. W. P. A. Hass, G. Seidel, and N. J. Poulis (Kamerlingh Onnes Laboratorium, Leiden, Netherlands). Physica 26, 834-52(1960) Oct.

The nuclear spin lattice relaxation time T_1 and the diffusion coefficient D of liquid hydrogen were measured between 14°K and 20°K by the spin echo technique. The temperature dependence of the quantities does not agree with recent predictions of their behavior. The observed dependence of T_1 on ortho hydrogen concentration indicates that the reorientation of the ortho molecules within the liquid is best explained in terms of a collision theory description. A discussion of the influence of diffusion on spin echoes is appended. (auth)

7347 ISOTOPE EFFECT IN BAND SPECTRA OF MAGNESIUM OXIDE. D. S. Pešić (Inst. of Nuclear Science, B. Kidrich, Belgrade, Yugoslavia). Proc. Phys. Soc. (London) 76, 844-8(1960) Dec.

Studies of the magnesium electronic spectrum in a vacuum arc in O^{18}, and in a mixture of O^{16} and O^{18} have been made. The measurements of isotope shift are given for the green and for the ultraviolet system. The isotope effect in the green system confirms the vibrational analysis of Mahanti and Lagerqvist. The bands in the ultraviolet region are attributed to a polyatomic molecule containing magnesium and oxygen atoms. The assignment is partly supported by the isotope shift, but the molecule only contains a single oxygen atom. (auth)

7348 COHESIVE ENERGY OF TlCl CRYSTAL. N. N. Kristofel. Trudy Inst. Fiz. i Astron., Akad. Nauk Eston. S.S.R. No. 12, 262-3(1960). (In Russian)

A quantum mechanical evaluation of the cohesive energy and lattice constants of TlCl crystals showed $a_0 = 3.40$ A and $U = -171.5$ kcal/mole. Corresponding experimental magnitudes were $a = 3.33$ A (T = 20°C) and $U = -170.9$ kcal/mole (a is the distance between Tl^+ and Cl^- ions). (R.V.J.)

7349 KINETICS OF THE REMOVAL OF RUTHENIUM TETROXIDE FROM AQUEOUS SOLUTIONS BY AIR STREAMS. A. A. Goryunov, R. L. Myuller, and L. K. Kapustina. Vestnik Leningrad. Univ. 15, No. 10, Ser. Fiz. i Khim. No. 2, 104-11(1960). (In Russian)

The kinetics of the removal of ruthenium tetroxide from nitric acid solutions at different temperatures and air velocities is studied. It is suggested that the process be limited by the rate of water evaporation. (auth)

7350 THE ACCUMULATION OF RADIOACTIVE ATOMS ON AEROSOLS (SUSPENDED PARTICLES). Lars Lassen and Günter Rau (Universität, Heidelberg, Ger.). Z. Physik 160, 504-19(1960). (In German)

The attachment of the decay products of thorium emanation to aerosol particles was studied. The dependence of the attached activity on the particle size was determined for spherical particles with radii R ranging from 0.04 to 0.6 μ. The particles used were homogeneous dioctylphthalate droplets and polystyrene microspheres. It was found that the attached activity is proportional to $R^2/(1 + hR)$. This dependence can be derived theoretically by considering the deposition to be solely governed by the duffusion process (not by electrostatic forces) and assuming a quasi-stationary density distribution for the diffusing atoms. The constant h is uniquely determined by the average gas kinetic velocity and the diffusion constant of the diffusing atoms. For the decay products of thorium and radium emanation (atomic weight ≈210) $h \approx 7 \cdot 10^4$ cm^{-1}. The derived equation holds for a wide range of particle sizes. For the particles with radii larger than about 10^{-4} cm, this means that the attachment is proportional to the radius; for particle radii below about 10^{-6} cm it is proportional to the surface (R^2) of the particles. It is also possible to derive an expression for the time-dependence of the attachment process from the theoretical considerations. The rate at which the average concentration of the radioactive atoms decreases is proportional to $\exp(-t/\tau)$ where $\tau = 1 + hR/\pi R^2 N\bar{v}$ ($\bar{v}$ = average gas kinetic velocity of the diffusing atoms; N = aerosol concentration). (auth)

7351 STUDIES ON THE SOLUBILITY OF ZIRCONIUM THORIUM AND URANIUM PHENYLARSONATES. V. A. Mikhailov. Zhur. Anal. Khim. 15, 528-33(1960) Sept.-Oct. (In Russian)

The solubility of sexa- and tetravalent uranium, zirconium, and thorium phenylarsonates in solutions of different acidity, in the presence of phenylarsonic acid, was studied by the labeled atom method. The conditions for their most complete precipitation were established and the solubility was determined as follows: uranium(VI) phenylarsonate 3×10^{-5} M; uranium(IV) phenylarsonate 1×10^{-5} M; zirconium phenylarsonate $(0.5 \pm 0.2) \times 10^{-5}$ M; and thorium phenylarsonate 10^{-5} M. The logarithms of the concentration constants for the reactions of phenylarsonate formation were calculated to be equal: uranium(VI) 2.2 ± 0.2; uranium(IV) 6.5 + 0.3; zirconium 11.5 ± 0.3; and thorium 3.8 ± 0.3. (auth)

7352 HEAT CAPACITY OF CERIUM DIOXIDE AT HIGH TEMPERATURE. F. A. Kuznetsov and T. N. Rezukhina (Moscow State Univ.). Zhur. Fiz. Khim. 34, 2467-(1960) Nov. (In Russian)

The average heat capacity of cerium dioxide was determined by the mixing calorimetry method at 608 to 1172°K. The experimental data for the temperature dependence of the mean specific heat are described by the equation $\bar{c}_p = 0.08895 + 1.42_2 \cdot 10^{-5}$ T. The equation $\bar{c}_p = 0.0847_7 + 2.84_4 \cdot 10^{-5}$ T holds for the temperature dependence of the specific heat. (auth)

7353 OXIDATIVE PROPERTIES OF ATOMIC HYDROGEN IN THE RADIATION OXIDATION OF FERROUS IONS. V. N. Shubin and P. I. Dolin (Inst. of Electrochemistry, Academy of Sciences, USSR). Zhur. Fiz. Khim. 34, 2480-8(1960) Nov. (In Russian)

The γ-ray induced oxidation of Fe^{2+} solutions in 0.8 N H_2SO_4 saturated with H_2 under pressure was investigated. The oxidation yield does not reveal any pressure dependence at 1 to 180 atm. This confirms the participation of atomic hydrogen in the oxidation process. If oxygen is present in the solutions, the process takes place according to a chain mechanism. From the experimental data the value $K_{H+OH}/K_{Fe^{2+}+OH} = 0.135$ was calculated. From a kinetic analysis of published data, the value of the rate constant of the reaction $H + H^+ \rightarrow H_2^+$ was found as 2.10^4 l/mole/sec. (auth)

7354 URANIL I EGO SOEDINENIYA. (Uranyl and Its Compounds). I. I. Lipilina. Moscow, Publishing House of the Academy of Sciences, 1959. 315p.

A general analysis is given of the properties of uranium minerals with uranyl content and of various prepared uranyl compounds. Studies were made of aqueous solutions of uranyl salts and of the coordination number and uranyl

distribution in aqueous structures. Organic solvent extraction and ion exchange are discussed. 591 references. (R.V.J.)

7355 IMPROVEMENTS IN OR RELATING TO THE PURIFICATION OF METALS. David Brian Wright, Trevor Robert Barrett, and Alfred John Martin (to United Kingdom Atomic Energy Authority). British Patent 856,073. Dec. 14, 1960.

A method for purifying beryllium from halogen impurities, especially chlorine, is outlined in which beryllium is milled to a powder of particle size <100 μ and heated to 825 to 875°C at reduced pressures (0.1 to 1 μ Hg) for 2 to 12 hr, or long enough to volatilize the impurities. An example of this method is given in which the chlorine impurity in electrolytically produced beryllium is reduced from 0.1 to 0.007 wt.%. (D.L.C.)

7356 IMPROVEMENTS IN THE PREPARATION OF METAL CHLORIDES. (to Columbia-Southern Chemical Corp.). British Patent 857,884. Jan. 4, 1961.

A process for chlorinating zirconium silicate ores under more moderate conditions (e.g., 50 to 200°C lower than formerly) is outlined in which a finely divided mixture of the zirconium ore and carbon is mixed with 0.2 to 5 wt.% boric oxide and then contacted with chlorine or some other chlorinating agent at 600 to 900°C. $ZrCl_4$ vapors are evolved and then recovered. An example of the process is given in which the vent gas composition and the ratio of ZrO_2 to SiO_2 chlorination were determined for various chlorination temperatures. The chlorination temperatures for various chlorine utilizations were also determined with and without boric oxide in the mixture. (D.L.C.)

Radiation Chemistry and Radiochemistry

7357 (AERE-M-749) THE PREPARATION AND TESTING OF IODINE-132 COLUMN GENERATORS. J. Robson (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Oct. 1960. 20p.

Preparation of sodium tellurite solution containing Te^{132} in a form suitable for application to an I^{132} alumina column generator and from which I^{132} may be distilled after acidification is described. An examination was made of all generator variables. A minimum bed depth of 0.9 in. of aluminum oxide was found necessary for a maximum of 10^{-3}% of the tellurium in 20 ml of separated I^{132} solution. Adverse effects were found for pretreatment of the generators before applying tellurite solution. The rate of application of tellurite solution to the generator and the necessary volume of subsequent washings have been studied. A capacity of 3.5 mg Te/g Al_2O_3 was found before the tellurium contamination measurably increased in the effluent. An apparatus is described for the remote application of tellurite solution to and subsequent washing of the generator. The technique of separating I^{132} was examined and separated I^{132} was found to be almost completely as iodide. A smaller generator to provide a more concentrated I^{132} solution is described. The results of tests for tellurium content in the separated I^{132} solution and of the I^{132} yield carried out on production model generators and a suitable packing container are described. (auth)

7358 (NAS-NS-3015) THE RADIOCHEMISTRY OF ZINC. Harry G. Hicks (Univ. of California. Lawrence Radiation Lab., Livermore). June 1960. 62p. OTS.

"Nuclear Science Series" of the National Research Council. Committee on Nuclear Science.

Included are a review of the nuclear and chemical features of particular interest to the radiochemist, a discussion of problems of dissolution of a sample and counting techniques, and a collection of radiochemical procedures for the elements as found in the literature. (W.L.H.)

7359 (NAS-NS-3017) THE RADIOCHEMISTRY OF IRON. J. M. Nielsen (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Aug. 1960. 46p. OTS.

"Nuclear Science Series" of the National Research Council. Committee on Nuclear Science.

Included are a review of the nuclear and chemical features of particular interest to the radiochemist, a discussion of problems of dissolution of a sample and counting techniques, and a collection of radiochemical procedures for the element as found in the literature. (W.L.H.)

7360 (NYO-9105) A STUDY OF THE MECHANISM OF RADIATION INDUCED GELATION IN MONOMER–POLYMER MIXTURES. Quarterly Summary Report [for] August 1, 1960 to October 31, 1960. (Radiation Applications Inc., Long Island City, N. Y.). Nov. 22, 1960. 8p. Contract AT(30-1)-2554.

Mixtures of polymers and multi-unsaturated monomers were prepared, irradiated, and the gel content determined. The gel content determination of crosslinked polyolefins was investigated in detail. The multi-unsaturated monomers used and radiation conditions applied have not given significant gel contents for polypropylene. The polypropylene resin used was characterized by differential extraction. (auth)

7361 (TID-11504) RADIOCHEMICAL STUDIES OF FISSION PROCESSES. Progress Report for April 1, 1960 to April 1, 1961. A. C. Wahl (Washington Univ., St. Louis). Dec. 19, 1960. 9p. Project No. 9. Contract AT(11-1)-85.

A procedure is described for the separation of yttrium from strontium by precipitation. A preliminary value for the fractional independent yield of Y^{93} from thermal-neutron fission of U^{235} is 0.02 ± 0.01. The fractional cumulative yield of Xe^{139} from spontaneous fission of Cf^{252} was determined as 0.67 ± 0.01. Charge distribution curves are shown for six fission-product chains from thermal-neutron fission of U^{235}. (W.L.H.)

7362 (TID-11574) APPLICATION OF FISSION PRODUCT SOURCES IN ORGANIC RADIATION CHEMISTRY. PART I. PROGRESS REPORT FOR THE YEAR ENDING DECEMBER 31, 1960. PART II. PROPOSED TECHNICAL PROGRAM. Weldon G. Brown (Chicago. Univ.). 13p. Contract AT(11-1)-754.

Experiments relating to the use of Kr^{85} gas, contained in a thin-walled glass bulb, as a β source for the irradiation of liquid materials contained in an annular space surrounding the bulb are described. A pilot model, charged with 300 millicuries of Kr^{85}, was operated successfully over a period of several months. No difficulties were encountered in the operation of the source, however difficulties in connection with dosimetry were not completely solved. Preliminary experimentation in connection with a proposal to utilize Pm^{147}, incorporated in the lattice of a synthetic molecular sieve, as a β source for the irradiation of organic materials is reported. It is shown that rare earth ions at sufficient concentration can be exchanged into the zeolite without collapse of the structure. Additional experiments were performed with respect to a proposal to incorporate promethium oxide into the inside

surface layer of glass reactor vessels and thereby to fabricate useful β sources. (auth)

7363 (USNRDL-TR-481) TRAPPED RADICALS IN IRRADIATED N-PROPANOL AT 77°K. R. S. Alger, T. H. Anderson, and L. A. Webb (Naval Radiological Defense Lab., San Francisco). Nov. 28, 1960. 20p.

The free radicals formed in solid n-propanol by radiolysis and photolysis were examined by electron paramagnetic resonance (EPR) techniques. Identification of the radicals is based on modifications in the EPR hyperfine (hf) structure introduced by substituting deuterium for hydrogen at selected positions in the molecules. Radiolysis leads to radical formation by removing a hydrogen atom from the α carbon while photolysis apparently favors hydrogen abstraction from the β carbons. While corroborative evidence regarding the hydrogen atoms was obtained from mass spectrographic analyses of the gas liberated during irradiation, the analysis also shows that some hydrogen gas escapes from other than the α and β carbon positions. The experimental EPR hf spectra are compared to a series of constructed spectra obtained by summing gaussian absorption curves according to the interactions indicated by the proposed models of the radicals. (auth)

7364 CHEMICAL EFFECTS OF THE (n,γ) ACTIVATION OF BROMINE IN THE ALKYL BROMIDES: THE HALOMETHANES. W. E. Harris (Univ. of Alberta. Edmonton). Can. J. Chem. 39, 121-30(1961) Jan.

Techniques for studying the chemical effects accompanying the neutron irradiation of the halomethanes with a neutron flux of only 10^8 neutrons/cm^2/sec are described. Results are presented from the irradiation of mixtures of bromine with the four bromomethanes and carbon tetrachloride. The formation of organic products which occur as the result of "hot," "hot-spot diffusive," and "thermal" reactions are discussed. The amounts of products resulting from these three types of reactions are estimated. Observations with respect to the formation of bromoethanes are also discussed. (auth)

7365 AN INVESTIGATION OF THE DESTRUCTION OF STARCH AS A FUNCTION OF THE DOSE OF IONIZING GAMMA RADIATION. V. F. Oreshko and K. A. Korotchenko (Moscow Technological Inst.). Doklady Akad. Nauk S.S.S.R., 133, 1219-22(1960) Aug. 11. (In Russian)

Potato starch with an initial moisture content of 16.6% was subjected to integral γ doses varying from 10^6 to 18.2×10^6 r. The pH of an aqueous extract after radiation decreased from 6.65 to 5.80. The content of reducing agents expressed as milligram of glucose per gram of starch increased with increasing dose from 0.35 to 9.85. The average molecular weight of the starch decreased with increasing dose from 462,000 to 16,500. Linear plots of 1/M (M = average molecular weight of the starch), content of reducing agent (milligram of glucose per gram of starch), and G/D (G, milligram of gaseous products per gram of starch, D, dose) vs. D (dose in roentgens) are presented, and equations are derived that describe the rate of the process of destruction. The average energy required to break a single bond was found to be 28.0 ev. Spectrophotometric curves show an increase in absorption at 220–240 mμ (similar to the formation of an anhydride from a monosaccharide), and a maximum at 260–265 mμ (due to the formation of formaldehyde or dioxyacetone). (TTT)

7366 ISOLATION OF WEIGHABLE QUANTITIES OF PURE PROTACTINIUM-231. Vict. I. Spitsyn and R. A. D'yachkova (Inst. of Physical Chemistry, Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R. 134, 1111-14(1960) Oct. 11. (In Russian)

The separation of protactinium from waste solutions by manganese dioxide coprecipitant resulted in a concentrate with 81% MnO_2, 4.1% SiO, 2.4% Fe_2O_3, 0.9% Al_2O_3, 0.4% TiO_2, 0.3% ZrO_2, 0.03% CaO, 1.5% P_2O_5, and 2.9% As_2O_5, with 2.5×10^{-4}% Pa (100-fold higher than initial concentration). The method used was applied in separating milligram quantities of protactinium from admixtures of niobium, titanium, and zirconium. The nuclear properties of the separated product were identical to the previously reported properties of protactinium-231. (R.V.J.)

7367 PREPARATIVE RADIATION CHEMISTRY. I. REACTION OF NITRIC OXIDE WITH SOME ORGANIC LIQUIDS INDUCED BY HIGH-ENERGY ELECTRONS. Arnim Henglein (Mellon Inst., Pittsburgh). Intern. J. Appl. Radiation and Isotopes 8, 149-55(1960) Oct. (In English)

Radiation-induced reactions of carbon tetrachloride, chloroform, trichlorobromomethane, trichloronitromethane, 1,1,1-trichloroethane, and cyclohexane solutions of nitric oxide were studied. Intense beams of 3 Mev electrons were used and the reactions were carried out up to conversions of about 10%. Trichloronitrosomethane is formed in carbon tetrachloride (G = 4.5), trichlorobromomethane (G = 5.2), and trichloronitromethane (G ~ 6). Dichloronitrosomethane, which has not been synthesized to date, is formed in chloroform (G ~ 0.5). Similarly, 1,1-dichloro-1-nitrosoethane was observed in the irradiation of 1,1,1-trichloroethane. The primary reaction product in cyclohexane is assumed to be cyclohexanone oxime which is immediately reduced by free organic radicals or hydrogen atoms to give the amine and the hydroxylamine. The observed reactions are explained by scavenging of free radicals from the radiolysis of the liquid by nitric oxide and, in some cases, subsequent changes of the nitroso compounds formed. (auth)

7368 DIRECT RADIATION GRAFTING ON TO HYDROPHILIC POLYMERS. A. Chapiro and V. Stannett (Centre National de la Recherche Scientifique, Bellevue, France). Intern. J. Appl. Radiation and Isotopes 8, 164-7 (1960) Oct. (In English)

Grafting of vinyl monomers onto films of polyvinyl alcohol, cellophane, cotton, etc. is greatly increased if water is added to the irradiated system. Irradiation of a dry system only leads to surface grafting whereas considerable depth grafting is achieved in the presence of water. The kinetics of the reaction are studied with polyvinyl alcohol films irradiated in styrene solutions in dioxane containing various amounts of water. The results are interpreted on the basis of the increased swelling of the polymer films in the presence of water and agree with independent data derived from sorption isotherms. (auth)

7369 IONIC AND FREE RADICAL PROCESSES IN THE RADIOLYSIS OF LIQUID METHYL AND ETHYL IODIDES. H. A. Gillis, R. R. Williams, Jr., and W. H. Hamill (Univ. of Notre Dame, Ind.). J. Am. Chem. Soc. 83, 17-29(1961) Jan. 5.

Liquid methyl and ethyl iodides were irradiated at room temperature with Co^{60} source at dose rates approximating 10^{19} ev hr^{-1} ml^{-1} in air-free samples with added HI and I_2. In ethyl iodide, C_4H_{10} is a small but significant product; $G(C_2H_4)$ decreases at HI or I_2 concentrations $>10^{-2}$ M; $G(C_2H_6)$ increases at HI concentrations $>10^{-2}$ M provided $I_2/HI \sim 0$; $G(C_2H_6)$ decreases at I_2 concentrations $>10^{-2}$ M provided $HI/I_2 \sim 0$; and $G(C_4H_{10})$ decreases at HI or I_2 concentrations $>10^{-2}$ M. In methyl iodide, $G(CH_4)$ increases at HI concentrations $>10^{-2}$ M and $G(C_2H_6)$ decreases at I_2 or HI concentrations $>10^{-2}$ M. These results indicate that C_2H_5 and CH_3 are involved in diffusion-controlled reactions as $2C_2H_5 \rightarrow C_4H_{10}$; $C_2H_5 + I \rightarrow C_2H_4 + HI$; $2CH_3 \rightarrow C_2H_6$, etc.

Disposition of radicals favorable to diffusion-controlled reencounters may arise from track effects in general. In particular they would be favored by the pairing of alkyl radicals following charge neutralization of the products of ion-molecule reactions, as $CH_3I^+ + CH_3I \rightarrow C_2H_6I^+ + I$ and $C_2H_5I^+ + C_2H_5I \rightarrow C_4H_{10}I^+ + I$, which were observed in the mass spectrometer. The reaction products are qualitatively and quantitatively consistent with electron impact cracking patterns as determined by mass spectrometry. (auth)

7370 RADIATION CHEMISTRY OF POLYDIMETHYLSILOXANE. II. EFFECTS OF ADDITIVES. A. A. Miller (General Electric Co., Schenectady, N. Y.). J. Am. Chem. Soc. 83, 31-6(1961) Jan. 5.

The electron irradiation of polydimethylsiloxane oil $[-Si(CH_3)_2O-]_n$ in the presence of several additives was studied. Oxygen decreases the crosslinking yield from the normal value of G = 3 to a limiting minimum value of G = 1, and it is concluded that these "residual" crosslinks are not peroxide (–O–O–) bonds. Reactive hydrogen transfer agents, such as mercaptans, are more effective than aromatic free-radical inhibitors (e.g., di-t-butyl-p-cresol, quinone) in retarding the crosslinking. The use of 10% mercaptan allows a direct measurement of primary $\rightarrow Si-CH_3$ scissions and the yield for these is G = 4, only slightly dependent on temperature between −40 and +100°. The yield of $\rightarrow SiOH$ end-groups formed by irradiation in the presence of 10% mercaptan indicates that, compared to crosslinking, radiation-induced free-radical scission of the siloxane backbone is negligible. The effects of H_2, diethyl disulfide, benzene, and tetralin on the radiation-crosslinking of polydimethylsiloxane are described. (auth)

7371 THE CHEMICAL ACTION OF IONISING RADIATION IN SOLUTION. PART XXIV. ACTION OF X-RAYS (200 kv) ON AQUEOUS SOLUTIONS OF ACETIC ACID AND GLYCOLLIC ACID. E. Hayon and J. Weiss (King's Coll., Newcastle-upon-Tyne, Eng.). J. Chem. Soc. 5091-7(1960) Dec.

The chemical action of 200-kv x rays on deoxygenated aqueous solutions of acetic acid and glycolic acid was studied, mainly as a function of pH and of the solute concentration, in order to distinguish the reactions of "self-trapped" electrons ("polarons") from those of hydrogen atoms formed from the polarons by the reaction $(H_2O)^- + H^+ \rightarrow H + H_2O$. The hydrogen atoms react by dehydrogenating α-positions to the carboxyl groups, giving molecular hydrogen; in the case of glycolic acid, the electron can attach itself to the OH group in the α-position according to: $(H_2O)^- + HO \cdot CH_2 \cdot CO_2H \rightarrow \cdot CH_2 \cdot CO_2H + OH^- + H_2O$; with glycolic or acetic acid (which does not have an electron-attracting group in the α-position), the polaron can react to some extent with the carboxyl group, which can then split up, leading to the formation of carbonyl radicals; and in acetic acid, $CH_3 \cdot CO \cdot$ is formed, which leads to formation of biacetyl. (auth)

7372 SELF-DECOMPOSITION OF [^{14}C] GLUCOSE. E. J. Bourne, D. H. Hutson, and H. Weigel (Univ. of London). J. Chem. Soc. 5153-9(1960) Dec.

D-[C^{14}] Glucose undergoes appreciable self-decomposition when stored in vacuo as a freeze-dried sample. Some of the products were identified by chromatography, electrophoresis, and carrier-dilution analysis. A comparison of these products with the products of the oxidation of D-glucose with Fenton's reagent suggests a similarity of the two reactions and the participation of hydroxyl radicals in the self-decomposition. (auth)

7373 PRODUCTION OF CARRIER-FREE NaF^{18}. R. Münze and L. Baraniak (Zentralinstitut für Kernphysik, Rossendorf, Ger.). Kernenergie 3, 989-91(1960) Oct.-Nov. (In German)

By irradiation of $LiNO_3$, targets with thermal neutrons F^{18} are produced by a secondary reaction. The carrier-free F^{18} is absorbed on $BaSO_4$ and thus separated from the main body of target materials. By washing the precipitate dissolved in H_2SO_4 with N_2 at high temperatures, it is possible to drive off about 40% of the F^{18} activity present as HF. The product has a high chemical and radiochemical purity and is useful for medical purposes. (tr-auth)

7374 RADIATION-INDUCED IONIC REACTIONS: THE RETARDATION OF THE HOMOPOLYMERIZATIONS OF α-METHYL STYRENE AND β-PINENE BY WATER. T. H. Bates, J. V. F. Best, and T. Ffrancon Williams (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Nature 188, 469-70(1960) Nov. 5.

The results are reported of an experiment which produces evidence in favor of the ionic polymerization of α-methyl styrene and β-pinene carried out in vacuo at the ambient temperature of a Co^{60} source. Both monomers were found to undergo a high degree of conversion to polymer without the marked reduction in rate as a function of amount of conversion that was previously observed for isobutene. In contrast to isobutene where the isolated polymer had an $\overline{M}_n$ exceeding 100,000 for less than 20% conversion, the $\overline{M}_n$ values obtained for α-methyl styrene and β-pinene polymers only correspond to ~15-monomer units in each case. Early experiments with β-pinene established that the polymer yield was sensitive to the pretreatment of the monomer and particularly to the drying agent. The use of silica gel for drying the liquid within the vacuum apparatus gave the highest yields yet recorded for β-pinene, G(-monomer) exceeding 3000 in some runs. A confirmation that the polymer yield is affected by the efficacy of the drying agent and not by the removal of other impurities is provided by the effect of deliberately added water to β-pinene; in this instance a sample of water-saturated monomer gave polymers with only a G(-monomer) of 6.8. A similar conclusion that water exerts a powerful retarding effect on radiation-induced polymerization of α-methyl styrene is afforded by a comparison of yields obtained with monomer samples which were passed over silica gel and then sealed in vacuo or equilibrated with excess water in the vacuum line prior to seal-off. The former case resulted in G(-monomer) values on the order of 10,000 whereas the latter condition gave an initial G value of ~10. (B.O.G.)

7375 RADIATION-INDUCED CARBOXYLATION OF ORGANIC COMPOUNDS: FORMATION AND REACTIONS OF THE CARBOXYL RADICAL ION. G. Scholes, M. Simic, and J. J. Weiss (Kings Coll., Newcastle-upon-Tyne, Eng.). Nature 188, 1019-20(1960) Dec. 17.

Results are presented from a study on the formation and reactions of the carboxyl radical during the radioinduced carboxylation of organic compounds. It is demonstrated that under certain conditions reduced carbon dioxide can be built into organic molecules with the formation of the corresponding carboxylic acids. Results are presented on the radiation chemistry of aqueous solutions of ethanol and methanol in the presence of carbon dioxide or sodium bicarbonate. (C.H.)

7376 LABELLING OF ORGANIC COMPOUNDS BY MERCURY-PHOTOSENSITIZED REACTION WITH TRITIUM GAS. Fulvio Cacace, Angelo Guarino, and Gabriella Montefinale (Universitá, Rome and Consiglio Nazionale delle Ricerche, Rome). Nature 189, 54-5(1961) Jan. 7.

A simple technique is described for labeling organic

compounds by mercury-photosensitized reaction with H^3 gas. In the method, a silica ampoule containing the organic sample and tritium gas, with a small amount of mercury, is irradiated at room temperature with a low-pressure mercury lamp. By this method, 10 mc of T_2 produced an activity in toluene that would have required 500 mc by other methods. (D.E.B.)

7377 A METHOD FOR MONITORING ELECTRODEPOSITION OF ALPHA-RADIOACTIVE ISOTOPES. A. A. Panomarev, G. I. Khlebnikov, and K. A. Gavrilov. Pribory i Tekh. Ekspt. No. 6, 58-60(1960) Nov.-Dec. (In Russian)

An improved method is suggested for observing the electrolytic deposition of α-active substances on thin base layers. The deposition rate, and quality as functions of current density, concentration of the electrolyte, and concentration of the precipitated material were studied using plutonium. It is shown that the optimum conditions for plutonium electrodeposition from a mixture of formic acid and ammonium formate are 150 ma/cm^2 current and an electrolyte concentration C ≃ 0.25 mol. (tr-auth)

7378 ANALYSIS OF RADIATION-INDUCED IONIC POLYMERIZATION OF ISOBUTENE. A. Charlesby (Royal Military Coll. of Science, Shrivenham, Wilts, Eng.), S. H. Pinner, and R. Worrall. Proc. Roy. Soc. (London) A259, 386-402(1960) Dec. 29.

Previously published experimental details of the radiation-induced polymerization of isobutene, together with new experimental details, are reviewed critically in the light of a kinetic scheme. The essential features of this scheme are initiation of polymerization by radiation-produced ions, propagation of polymer chains by a carbonium ion mechanism, termination of chains by a unimolecular process, termination of chains by a bimolecular process involving reaction with a radiation-produced inhibitor, and degradation of polymer molecules by further radiation. Various reaction constants are deduced; in particular, the G value for ionic initiation is about 0.19 at −78.5°C. In the bulk monomer at −78.5°C, these reactions occur simultaneously. In a solvent for both monomer and polymer at this temperature, the initiation step is modified in that only the energy absorbed by the monomer can initiate polymerization. In a solvent that allows precipitation of polymer, while this latter condition is still fulfilled, the bimolecular termination step is largely inoperative. In the presence of solid additives that are capable of increasing the polymer yield, the rate of the initiation reaction is increased, and G values for ionic initiation of up to 2.9 are deduced. Such investigations can provide information on the fate of the electron ejected by ionization. In all these cases degradation of the already formed polymer by further radiation occurs, and this largely controls the average degree of polymerization; transfer reactions play little part. (auth)

7379 EFFECT OF γ-RAY IRRADIATION ON GELATIN SOLUTIONS. Yoshitada Tomoda and Minoru Tsuda. Tokyo Kôgyô Shikensho Hôkoku 55, 490-501(1960) Dec. (In Japanese)

Gelatin solutions were irradiated by γ rays emitted from Co^{60} and the effect was studied by measurements of melting point, jelly strength, and viscosity of the solutions. Gamma irradiation of dry gelatin with a dose of 10^7 r caused little change in melting point or viscosity, but irradiation of gelatin solutions resulted in elevation of melting point, increase of jelly strength, and increase of viscosity. Irradiations over 2×10^5 r led gelatin solutions to a gel state which is insoluble in hot water. Elevation of melting point or increase of viscosity of gelatin solutions after γ-ray irradiation is probably due to intermolecular linkage. In this case, the role of water must be noted. The presence of oxygen during the irradiation led to a gradual decrease of gelatin solution viscosity. This is presumably due to the inhibiting action of oxygen toward linkage formation of gelatin molecules. (auth)

7380 ELUTION CURVES AS A MEANS OF STUDYING RADIOELEMENT STATES IN SOLUTION. V. I. Paramonova, V. I. Altynov, V. B. Kolychev, and A. V. Zharkov. Vestnik Leningrad. Univ. 15, No. 16, Ser. Fiz. i Khim, No. 3, 74-9(1960). (In Russian)

A method of studying radioelement states in solution is proposed. The method is based on the comparison of the radioelement elution curves with the standard elution curves for the same element in the solution. The method allows for the semiquantitative determination of the presence of cations, and neutral or anion complexes in the solution as well as colloidal forms of the element in different combinations. (auth)

7381 MECHANISM OF THE RADIOLYSIS OF SOLID OXALIC ACID. A. Ya. Temkin (Inst. of Oil-Chemical Synthesis, Academy of Sciences, USSR). Zhur. Fiz. Khim. 34, 2503-5(1960) Nov. (In Russian)

A comparison of the calculations described with the experimental data of the investigation shows that radiochemical reactions in solid oxalic acid, proceeding according to a radical mechanism, takes place in the tracks. It may be expected that this is true also for other solids that are not conductors or semiconductors. (auth)

7382 RADIOXIDATION OF Fe^{2+} IONS IN KBr SOLUTIONS. S. A. Brusentseva and P. I. Dolin (Inst. of Electrochemistry, Academy of Sciences, USSR). Zhur. Fiz. Khim. 34, 2513-16(1960) Nov. (In Russian)

The addition of KBr to $FeSO_4$ solution in 0.8N H_2SO_4 lowers the yield of radio-oxidation of ferrous iron by γ rays of a Co^{60} source from 15.6 to 12.3 in the presence of air and from 8.10 to 4.4 in a degassed solution. The diminished yield is caused by competing reactions of OH radicals with Br^- and Fe^{2+} ions, and of H atoms with Br and Fe^{3+}. The dependence of the yield of Fe^{2+} oxidation upon the concentration ratio $[Fe^{2+}]:[Br^-]$ permitted the ratio of the rate constants of reaction between OH radicals and Fe^{2+} and Br^- to be determined. This was found to equal 90. (auth)

7383 GRAFT COPOLYMERS AND PREPARATION THEREOF. (to Rohm & Haas Co.). British Patent 855,711. Dec. 7, 1960.

Graft copolymers having desirable properties may be prepared by mixing a poly(alkylacrylate) (the polymer reactant) with a monomer and exposing to high-energy radiation to a total dose of 5×10^5 to 2×10^6 rep. The polymer reactant must be one in which the alkyl portion contains no more than 8 carbon atoms and does not have a tertiary carbon atom attached directly to the adjacent oxygen atom, and it should have an average molecular weight of 10^4 to 10^6. Examples of monomers that may be used in the above manner are methyl acrylate, acrylonitrile, acrylic acid, styrene, etc. The proportion of the polymer and monomer should be 35 to 65 wt. % of either one, and the reaction preferably should be carried out in the anaerobic condition and at a temperature between 0 and 70°C. (D.L.C.)

7384 IRRADIATION METHOD OF CONVERTING ORGANIC COMPOUNDS. A. O. Allen and J. M. Caffrey, Jr. (to U. S. Atomic Energy Commission). U. S. Patent 2,955,997. Oct. 11, 1960.

A method is given for changing the distribution of organic compounds from that produced by the irradiation of bulk alkane hydrocarbons. This method consists of depositing an alkane hydrocarbon on the surface of a substrate material and irradiating with γ radiation at a dose rate of more than 100,000 rads. The substrate material may be a metal, metal salts, metal oxides, or carbons having a surface area in excess of 1 m^2/g. The hydrocarbons are deposited in layers of from 0.1 to 10 monolayers on the surfaces of these substrates and irradiated. The product yields are found to vary from those which result from the irradiation of bulk hydrocarbons in that there is an increase in the quantity of branched hydrocarbons.

7385 SAMPLING SYSTEM. B. A. Hannaford, R. Rosenberg, C. L. Segaser, and C. L. Terry (to U. S. Atomic Energy Commission). U. S. Patent 2,968,183. Jan. 17, 1961.

An apparatus is given for the batch sampling of radioactive liquids such as slurries from a system by remote control, while providing shielding for protection of operating personnel from the harmful effects of radiation.

Raw Materials and Feed Materials

7386 (CEA-1661) INFLUENCE DE L'ATMOSPHERE SUR LA REACTIVITE DES POUDRES D'OXYDE D'URANIUM. (The Influence of the Atmosphere on the Reactivity of Uranium Oxide Powders). Y. Carteret, M. Portnoff, J. Elston, and R. Caillat (France. Commissariat à l'Énergie Atomique. Centre d'Études Nucléaires, Saclay). 1960. 19p.

The reactivity of the UO_2 powders in different atmospheres (hydrogen, vacuum, or argon) was studied by measuring their specific surface. The influence of the nonstoichiometry was also examined. In hydrogen, the specific surface of the UO_2 powder decreases from 900°C. In argon or under vacuum the surface of a stoichiometric oxide quickly decreases between 700 and 800°C, the effect being more important as the initial surface is larger. If traces of oxygen are present before the experience, the surface begins to diminish at 500°C. There is a relation between the reactivity of UO_2 powder and its specific surface. The reactivity is higher in argon or under vacuum than in hydrogen, and it is higher for a nonstoichiometric oxide. (auth)

7387 (CF-59-10-21) CONTINUOUS PRECIPITATION OF AMMONIUM DIURANATE. D. J. Price (Oak Ridge National Lab., Tenn.). Oct. 20, 1959. 9p.

Ammonium diuranate (ADU) was prepared by a continuous precipitation method to correlate particle size, shape, and surface area with a parameter, γ, which is a quantitative measure of precipitation conditions. No consistent variation of average particle diameter and surface area of the various ADU products with γ was observed. (auth)

7388 (NLCO-650) SUMMARY TECHNICAL REPORT FOR THE PERIOD JULY 1, 1956 TO SEPTEMBER 1, 1956. John W. Simmons, ed. (National Lead Co. of Ohio, Cincinnati). Oct. 15, 1956. Decl. Mar. 15, 1960. 176p. Contract AT(30-1)-1156. OTS.

The activities of the Technical Division, including the HNO_3 recovery process, a study of UO_3 factors as related to the production of metal-grade UF_4, a thermobalance investigation of starch as a reducing agent for UO_3, reduction of UF_4 to uranium by a thermite type reaction, melting and casting of Nb–U alloy, uranium recovery from scrap materials, preparation of uranium shot, calcium reduction of ThO_2, production of thorium ingots, "wet chemical" and spectrochemical development, ammonia precipitation and filtration studies from uranyl nitrate solutions, and preparation of active UO_2 from UF_6 are reviewed. (W.L.H.)

7389 THE AVAILABILITY OF URANIUM FOR A NUCLEAR POWER INDUSTRY. R. A. Laubenstein and C. Starr (Atomics International Div., North American Aviation, Inc., Canoga Park, Calif.). At. Age No. 1, 3-18(1960) Apr. (AI-4945)

A study of the economically available resources of uranium in the U.S.A. and in the world indicates that these resources will increase rapidly as the price of uranium ore is increased. At present ore prices, available uranium in the U.S.A. should be sufficient to maintain the nuclear power industry in this country until the year 2005. On a world-wide basis, sufficient uranium should be available from known economical reserves to support the nuclear power industry until at least the year 2050 with no increase in the price of uranium beyond the present range of prices. These general conclusions are reached if the reactor type assumed for nuclear power generation has characteristics similar to a high-temperature, high-specific-power system. For a low-temperature, low-specific-power system, similar conclusions on a partially-reduced time scale would result. The high-temperature, high-specific-power system, will yield more electric energy per ton of uranium and will be less sensitive to possible increases in its price. The study indicates that there is appreciable incentive to the development of high-temperature, high-specific-power reactors (such as the liquid-metal-cooled) as compared with the low-temperature, low-specific-power types (water- or organic-cooled). For example, present fuel costs for the low T. and S.P. reactors with U_3O_8 at $10/lb are equivalent to the costs for the high T. and S.P. reactors with U_3O_8 at $26/lb. Such an increase in permissible ore cost would increase uranium resources by a factor of six. A large increase in the energy obtained per ton of natural uranium could result from the development of a system for burning plutonium with a reasonably high conversion ratio, such as plutonium recycle or a plutonium fast reactor. The advent of the plutonium breeder (conversion ratio greater than 1) would permit the optimum utilization of the world's potential uranium resources. (auth)

7390 IMPROVEMENTS IN THE PREPARATION OF AMMONIUM DIURANATE. (to Mallinckrodt Chemical Works). British Patent 854,235. Nov. 16, 1960.

A fine and dense form of ammonium diuranate of bulk density ≥ 1.4 g/cm^3 and ultimate particle diameter ≤ 3 μ can be prepared by precipitation; the precipitation is carried out in an aqueous solution containing in each gallon 0.3- to 0.6-lb uranium, 0.15- to 0.3-lb fluoride, and an excess of 0.2-lb NH_3 over that required to neutralize any acid present and to form ammonium diuranate. The precipitate is filtered off without washing or drying. UF_6 can be converted into ammonium diuranate in this way by hydrolyzing before precipitating the diuranate, and the resulting product is particularly useful for manufacturing dense UO_2-sintered compacts. Three examples of this method are given in which the starting material is UF_6 vapor, UO_2F_2, and ammonium diuranate for upgrading. A table giving representative bulk densities of the resulting diuranate and UO_2 produced therefrom is included. (D.L.C.)

7391 A PROCESS OF AND APPARATUS FOR PRODUCING URANIUM FLUORIDE. (to Commissariat à

l'Énergie Atomique). British Patent 855,217. Nov. 30, 1960.

A method and apparatus for producing UF_4 by fluorination of uranium oxide are described in which UO_3 and U_3O_8 are agglomerated into pellets and passed into a vertical reducing tubular oven where it falls in counterflow to the NH_3 + H_2 reducing gases and then passed in a similar manner into a fluorinating oven in counterflow to HF gas. The reducing and fluorinating gases are kept from mixing by a N_2 flow at the junction of the two ovens; automatic manometer means is provided for maintaining the N_2 pressure above that of the other gases. Drawings are included. (D.L.C.)

7392 PURIFICATION OF URANIUM HEXAFLUORIDE. (to Allied Chemical Corp.). British Patent 858,161. Jan. 11, 1961.

An efficient and economical method for removing impurities, particularly VOF_3, from crude UF_6 is given. The pure UF_6 obtained is suitable for isotope separation or metal production. Crude UF_6 vapors (≤ 0.5 wt. % VOF_3) are repeatedly contacted with a cooled surface at a temperature 10 to 15°C below the liquefaction temperature of UF_6 until the VOF_3 impurity is substantially deposited as a solid. The solid deposited on the cool surface contains ~80% VOF_3 and 9% UF_6. An example is given in which UF_6 containing 0.8% volatile constituents boiling below UF_6, 0.1% VOF_3, and 0.3% constituents boiling above UF_6 is continuously purified to give a product containing less than 0.01% each of these impurities. A flowsheet illustrating the application of this method to continuous operation is included. (D.L.C.)

7393 DIRECT INGOT PROCESS FOR PRODUCING URANIUM. W. M. Leaders and W. S. Knecht (to U. S. Atomic Energy Commission). U. S. Patent 2,960,398. Nov. 15, 1960.

A process is given in which uranium tetrafluoride is reduced to the metal with magnesium and in the same step the uranium metal formed is cast into an ingot. For this purpose a mold is arranged under and connected with the reaction bomb, and both are filled with the reaction mixture. The entire mixture is first heated to just below reaction temperature, and thereafter heating is restricted to the mixture in the mold. The reaction starts in the mold whereby heat is released which brings the rest of the mixture to reaction temperature. Pure uranium metal settles in the mold while the magnesium fluoride slag floats on top of it. After cooling, the uranium is separated from the slag by mechanical means.

7394 PRODUCTION OF PLUTONIUM METAL. W. L. Lyon and R. H. Moore (to U. S. Atomic Energy Commission). U. S. Patent 2,968,547. Jan. 17, 1961.

A process is given for producing plutonium metal by the reduction of plutonium chloride, dissolved in alkali metal chloride ± aluminum chloride, with magnesium or a magnesium–aluminum alloy at between 700 and 800°C and separating the plutonium or plutonium–aluminum alloy formed from the salt.

Separation Processes

7395 (AERE-R-3509) PRETREATMENT WITH HYDRAZINE PRIOR TO THE URANIUM PURIFICATION CYCLE OF A TBP PROCESS. A. G. Wain, R. J. W. Streeton, E. N. Jenkins, J. M. Fletcher, and P. G. M. Brown (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Dec. 1960. 16p.

Experiments are described which show that the ruthenium decontamination factor in the uranium purification cycle of a TBP process can be substantially improved by heating the feed with hydrazine nitrate. (auth)

7396 (CF-59-5-89) VOLATILITY: FLUORINATOR DESIGN FV-100, Zr–U FUEL ELEMENT PROCESSING PHASE. J. B. Ruch (Oak Ridge National Lab., Tenn.). May 28, 1959. 15p.

Volatility Pilot Plant Mark III Fluorinator is a double-chamber type vessel, each chamber $2\frac{1}{2}$ ft by 16 in. outside diameter separated by a 5-in. pipe 15 in. long. ASME flanged and dished heads are used for the chamber tops and conical sections with a 60° apex angle for the chamber bottoms. A new furnace designed to maintain the complete lower chamber (molten salt+ freeboard) above melt temperature is to eliminate past experiences of salt solidification on the wall, heads, and in or on the internal process lines. External pipe runs are autoresistance heated to allow melting and drain back of salt plugs. The upper chamber serves as a gas de-entrainment and solids precipitation device to retain most of the entrained salt and condensable fluorides in the 100 to 400°C range. (auth)

7397 (CF-59-5-108) REPROCESSING OF ARE FUEL VOLATILITY PILOT PLANT RUNS E-1 AND E-2. C. L. Whitmarsh (Oak Ridge National Lab., Tenn.). May 11, 1959. 42p.

After two batches (~340 kg) of fluoride salt from the ARE were reprocessed, a pilot plant operations were terminated because of a leak through which an estimated 780 g of uranium (as UF_6) escaped. Of the 21 kg of highly enriched uranium in the feed, 93.12% was collected as UF_6 product, 0.13% represented measured losses, and 3.72% was unaccounted for (leak). An additional 3.03% was reclaimed from NaF beds and equipment washes. The produce met both chemical purity and activity specifications for product level UF_6. Decontamination from fission products was essentially complete. A gross γ decontamination factor was apparently limited by the low activity of the feed salt. (auth)

7398 (CF-59-6-15) COMPARISONS OF ORGANIC EXTRACTANTS FOR IRRADIATED URANIUM: TRIBUTYL-PHOSPHATE VS DI-SEC-BUTYL PHENYLPHOSPHONATE, DI-N-BUTYL PHENYLPHOSPHONATE, TRI-CAPRYL-PHOSPHATE AND TRI-SEC-BUTYLPHOSPHATE. A. T. Gresky and R. G. Mansfield (Oak Ridge National Lab., Tenn.). June 5, 1959. 87p.

Batch extraction scouting tests were performed to establish comparisons of distribution coefficients for uranium, thorium, fission product, and/or plutonium in systems involving several classes of organic phosphorus compounds (diluted in Amsco 125-82 and/or xylene) and aqueous nitrate or nitric acid solutions. Results have substantiated previous conclusions which suggested (1) that the branched secondary alkylphosphates and alkylphenylphosphonates would generally afford uranium separation factors (from thorium and fission products) superior to those obtainable by tributylphosphate (TBP, a normal alkylphosphate); and (2) that the phenylphosphonates would afford reasonably higher extractability of uranium. Preliminary data from irradiation tests with di-sec-butyl phenylphosphonate also support a previous conclusion (3) that the phenyl group affords greater radiation stability of the organo-phosphorus compounds. Since the compound di-sec-butyl phenylphosphonate (DSBPP) effectively combines the above advantages (1), (2), and (3), it has received especial attention as a potential practical competitor for TBP as a recovery process extractant. Results of preliminary counter-current extraction tests

with di-n-butyl phenylphosphonate and di-sec-butyl phenylphosphonate, in simulated uranium extraction processes, are reported. Since only low-radioactivity aqueous feeds were employed, definitive values of decontamination efficiency were not obtained. The distribution data from first cycle comparison tests of DSBPP vs. TBP suggests that minor modifications of existing process conditions will permit uranium and plutonium decontamination factors which are somewhat higher than those now available in the first cycles of the Purex, TBP-25, and/or Interim-23 processes. (auth)

7399 (CF-59-6-51) THE EFFECTS OF TEMPERATURE AND COMPOSITION ON THE MERCURY VAPOR PRESSURE IN THE URANIUM–MERCURY SYSTEM. H. C. Forsberg (Oak Ridge National Lab., Tenn.). June 11, 1959. 8p.

The vapor pressure of mercury is lowered by increased concentration of uranium. By dew-point measurements, the vapor pressure at 175°C was found to vary between 2 and 8 mm Hg, and at 375°C, between 300 and 1100 mm Hg, depending upon composition. Plots of the log of mercury vapor pressure as a function of the reciprocal of absolute temperature gave a family of straight lines. Each line corresponded to one of the compositions: UHg_2, UHg_3, UHg_4, and a saturated solution of UHg_4 in mercury. No mutual solubility of the intermetallics was indicated. (auth)

7400 (CF-59-7-142) THE RATE OF URANIUM SORPTION BY A STRONG-BASE ANION-EXCHANGE RESIN. J. S. Newman (Oak Ridge National Lab., Tenn.). July 8, 1959. 15p.

The rate of uranium sorption by a strong-base anion-exchange resin (Dowex 21K) from a uranyl sulfate solution (U 0.005 M, H_2SO_4 0.02 M, SO_4^{2-} 0.2 M) was studied using a stirred vessel technique and measuring the U^{235} gamma radiation on each bead. Resin initially in the chloride form and the sulfate form was studied. The data fit, reasonably well, the equation of Boyd, Adamson, and Myers for "particle diffusion." Values of the apparent diffusion coefficient obtained are 10.2×10^{-8} and 7.2×10^{-8} cm^2/sec for the chloride and sulfate forms, respectively. For any one run, the value was observed to increase as the exchange proceeded. (auth)

7401 (CF-59-10-58) VOLATILITY PROGRAM REVIEW, OCTOBER 1958–SEPTEMBER 1959. R. P. Milford (Oak Ridge National Lab., Tenn.). Oct. 9, 1959. 26p.

A review is given of the ORNL fused salt-fluoride volatility process, which consists basically of volatilizing UF_6 from a fluoride salt melt. The uranium contained in the charge to the fluorinator may originate from either heterogeneous or homogeneous fuel elements. Recent activities were devoted to the following: conversion of the existing volatility pilot plant to study the processing of uranium–zirconium fuel elements and the engineering problems required to support this effort; the development of improved head-end steps for the conversion of uranium–zirconium fuel elements to ZrF_4 and UF_4; and the application of the volatility process to the recovery of uranium from MSR and to the recovery of the $Li^7F–BeF_2$ solvent salt for reuse by an HF dissolution process. (B.O.G.)

7402 (CF-59-10-136) HIGH SPEED CONTACTOR. R. Simms (Oak Ridge National Lab., Tenn.). Oct. 8, 1959. 29p.

A series of three hydroclones (¾ in. top dia., ¼ in. bottom dia., 3 in. long), placed in a column arrangement one above another, was operated successfully as a continuous countercurrent high speed contactor for solvent extraction. The device had an over-all stage efficiency of approximately 100% for the stripping of benzoic acid from kerosene into 0.08 M nitric acid. The kerosene phase moved up the column in the vortex of the hydroclone, while the water phase moved down at the walls. Maximum throughput at flooding was 5.5 gph for a recirculation rate per stage of 65 gph. (auth)

7403 (DP-519) REPROCESSING OF POWER REACTOR FUELS. Quarterly Progress Report No. 11 [for] April 1, 1960 to July 1, 1960. Leon H. Meyer, comp. (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). Aug. 1960. 17p. Contract AT(07-2)-1.

Electrolytic dissolution in HNO_3 was successfully applied to unirradiated stainless steel–UO_2 cermet fuels and to Al–U alloy. Interrupting the current during electrolytic disintegration of Zr–U alloy improved the mechanical operation but did not improve the recovery efficiency of uranium. An anode basket with a V-shaped bottom was superior to a flat-bottomed basket in maintaining contact with elements during electrolytic dissolution. The uranium was satisfactorily recovered from stainless-steel-clad UO_2 elements by electrolytic dissolution in HNO_3, followed by solvent extraction. The uranium was recovered from unirradiated Zr–U fuels by chemical dissolution in solutions with low controlled-free fluoride concentration followed by solvent extraction. Rates of corrosion of 304L and 309SCb stainless steel by 10M HNO_3, containing dissolved 304L stainless steel, were significantly higher than the rates for corresponding solutions 4M in HNO_3. Vapor phase corrosion of 309SCb stainless steel by $HF–HNO_3$ solutions was greater than the liquid phase corrosion. The reverse was true for corrosion of 309SCb stainless steel by $NH_4F–NH_4NO_3$ solutions. (auth)

7404 (DP-526) DECOMPOSITION OF THE TRIBUTYL PHOSPHATE–NITRATE COMPLEXES. G. Starr Nichols (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). Nov. 1960. 23p. Contract AT(07-2)-1. OTS.

Rates of decomposition are reported for the tributyl phosphate complexes of uranyl nitrate and nitric acid under isothermal and adiabatic conditions. These data are used to estimate conditions at which the decomposition reaction becomes self-accelerating. (auth)

7405 (DP-546) REPROCESSING OF POWER REACTOR FUELS. Quarterly Progress Report No. 12 [for] July 1, 1960 to October 1, 1960. Edward S. Occhipinti, comp. (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). Jan. 1961. 8p. Contract AT(07-2)-1. OTS.

Unirradiated elements made of graphite–14% uranium, UO_2 clad with stainless steel, and UO_2 clad with Zircaloy-2 were disintegrated electrolytically in boiling 10M nitric acid. The sludge deposited at the bottom of the dissolver contained less than 0.1% of the total uranium for each test; the remainder of the uranium went into solution. Excessive loss of uranium (20 to 60% of the total uranium) to the sludge formed when unirradiated zirconium–low uranium alloy disintegrated electrolytically in 10M nitric acid was not effectively reduced by varying current densities from 0.03 to 2.5 amp/cm^2, with alternating current, direct current, or interrupted direct current. The sludge formed when unirradiated zirconium–low uranium alloy disintegrated electrolytically in potassium iodide contained 9 to 15% of the total uranium. (auth)

7406 (HW-62847) DESIGN CRITERIA FOR THE MECHANICAL PROCESSING CELL. PLANT MODIFICA-

TIONS FOR REPROCESSING NON-PRODUCTION REACTOR FUELS. PROJECT CGC-830. R. A. Kennedy and G. H. Salzano (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Mar. 7, 1960. 22p.

The mechanical cell will be located in Cell 2 of 221-U Building. Cell 1 and the present galleries will be used as operating areas. The cell proper will contain a saw and a shear for cutting fuel assemblies and special tools will be provided for unusual disassembly operations. A manipulator-crane and special conveyers will be used for material handling. Fuel will be carried to and from the mechanical cell by the existing canyon crane. The cell will be partially filled with water to provide cooling for fuel in process and to contain the dust generated by the cutting operations. All operations will be controlled visually through shielding windows. Dissolver debris will be dumped on a table in front of a shielding window for examination. Study drawing SK-2-18164 is included as a feasible arrangement of the cell and its auxiliaries. It is not to be considered as a final arrangement. (auth)

7407 (HW-66439) THE SULFEX PROCESS TERMINAL DEVELOPMENT REPORT. F. D. Fisher (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Aug. 22, 1960. 26p. Contract AT(45-1)-1350.

Sulfex dissolutions of stainless steel were carried out in a series of experiments which culminated in demonstration decladdings of simulated fuel elements in a prototype-scale recirculating dissolver. The feasibility of decladding stainless-steel clad fuels with H_2SO_4 was conclusively demonstrated. Decladding rates were observed to vary with type of stainless steel and with type of sparge gas, either superheated steam or air. Passivation of stainless steel was of no consequence when the fuel elements were coupled to carbon steel and nitrate ion concentration was maintained below 0.01 M. Uranium losses to the decladding solutions were found to be inconsequentially low in all cases. Hydrogen explosion hazard was controllable by varying the acid concentration where air sparge or purge gas rates were scaled to correspond to those proposed for a production facility. The stainless-steel dissolution products are soluble to the extent of about one molar where the sulfuric acid concentration is below five molar. Corrosion of the Hastelloy F dissolver complex is appreciable and increases as acid concentrations and contact times increase. (W.L.H.)

7408 (HW-66441) ION EXCHANGE SEPARATION AND COULOMETRIC TITRATION OF PLUTONIUM IN IRRADIATED FUEL ELEMENT SOLUTIONS. J. W. Handshuh (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). June 15, 1960. 21p. Contract AT(45-1)-1350. OTS.

Ion-exchange resins and techniques were developed, and specific anion-exchange purification procedures for plutonium are described. Additionally a controlled potential coulometer on which micro-quantities of plutonium can be accurately titrated was developed. Recent Hanford studies approaching this problem with a combination of these two techniques are described. This involves the quantitative separation of the plutonium in a sample of dissolver solution by ion exchange and the measurement of the separated plutonium with a controlled potential coulometer. (auth)

7409 (IDO-14522) MODIFICATIONS FOR THE STR FUEL RECOVERY PROCESS. O. W. Parrett (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). Dec. 1, 1960. 52p. Contract AT(10-1)-205.

In a program directed toward the optimization of the process chemistry of the STR hydrofluoric acid method of reprocessing zirconium–uranium alloy fuels, it was shown that the process can be modified to dissolve homogeneously fuels of higher uranium content by either hydrogen peroxide oxidation or dilution of the dissolver solution. Rate of corrosion of Monel was acceptable with both methods of dissolution. Phase and stability studies of the solvent extraction feed and waste solutions indicated that higher concentrations of zirconium and uranium could be used in the process streams. Metastable solutions were obtained when the currently used STR raffinate solutions were evaporated. This operation was not favored for flowsheet use. The batch and continuous dissolution and solvent extraction flowsheets are given embodying the principal results of this study. (auth)

7410 (NAA-SR-5506) REPROCESSING OF THORIUM–URANIUM FUELS BY LIQUID METAL EXTRACTION. R. E. Johnson and J. D. Chilton (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Dec. 1, 1960. 19p. Contract AT-11-1-GEN-8.

Liquid-metal extraction techniques were applied to low decontamination reprocessing of two systems. In the first, the liquid system thorium-uranium-aluminum was subjected to extraction by molten lead and molten thallium. Thorium, uranium, aluminum, and fission products were found to be largely insoluble in thallium or lead. In the second, thorium and uranium were dissolved in zinc at a high temperature and precipitated at a lower temperature followed by filtration. Fission products were partially removed from the thorium and uranium by the zinc. Per cent removals for the rare earths and for the elements Pa, Ru, Ce, Zr, and Te were near 50%, whereas Sr and Cs were removed to an extent of over 95%. (auth)

7411 (ORNL-3045) McCABE-THIELE GRAPHICAL SOLUTION OF URANIUM–THORIUM PARTITIONING FROM 30% TBP–AMSCO SOLVENT. A. D. Ryon (Oak Ridge National Lab., Tenn.). Jan. 31, 1961. 14p. Contract W-7405-eng-26.

McCabe-Thiele diagrams showed uranium and thorium losses of <0.05% and 0.3%, respectively, with five stages each in the stripping and scrubbing steps in partitioning of uranium and thorium. The results were confirmed experimentally in a batch countercurrent test. The procedure considered was stripping of thorium from a 30% TBP–Amsco 125-82 solution by dilute nitric acid and scrubbing the uranium from the thorium strip with fresh solvent. (auth)

7412 (TID-11398) KINETICS OF URANIUM AND FISSION PRODUCT FLUORIDE ADSORPTION BY SODIUM FLUORIDE. Final Report to January 1959. J. H. Krause and J. D. Potts (Houdry Process Corp. Research and Development Labs., Linwood, Penna.). Apr. 18, 1960. 50p. For Oak Ridge National Lab. Contract W-7405-eng-26, Subcontract 2010. (60-OCR-1). OTS.

Results of a program to measure the kinetics of adsorption and desorption of volatile metal fluorides by sodium fluoride are described. Most effort was concentrated on uranium hexafluoride, while other fluorides such as those of silicon, molybdenum, tellurium, ruthenium, and iodine were examined briefly. (J.R.D.)

7413 (TID-11575) SOLVENT EXTRACTION STUDIES. A Progress Report. C. Gerald Warren (Western State Coll. of Colorado, Gunnison). Jan. 1961. 38p. Contract AT (11-1)-749.

Hydrogen 2-ethylhexyl phenacylphosphonate was prepared by hydrolysis of bis(2-ethylhexyl)phenacylphosphonate and

used to extract scandium, yttrium and lanthanum from their aqueous solutions. The formula and the stability of the organic soluble complex were established by correlation of the distribution with the concentration of the reagents in the system. The variation of the distribution of the metal and the formula of the chelate was explained in terms of the size of the metal ion and the size of the organophosphorus reagent. (For preceding period see TID-6150.) (auth)

7414 (UCRL-Trans-627(L)) FOCUSING ION EXCHANGE. IV. THEORY OF THE FOCUSING EFFECT. (Über fokussierenden Ionenaustausch. IV. Zur Theorie des Fokussierungseffektes). Ernst Schumacher. Translated by Richard B. Mudge from Helv. Chim. Acta 40, 2322-40(1957). 35p. (Includes original, 7p.).

A theoretical study of concentration focusing in electrophoresis is presented. The term "focusing ion exchange" is defined, and a discussion of the calculation model is given. Expressions for (1) nonstationary electrophoresis with complex formation, (2) diffusion-restricted focusing, and (3) rate-of-reaction restricted stationary focusing are derived. The effects of process parameters on the line-width of a focusing substance are also investigated. (J.R.D.)

7415 SALT FUSION IN NUCLEAR TECHNOLOGY. H. U. Woelk (Hahn-Meitner-Institut fur Kernforschung, Berlin). Chem.-Ingr.-Tech. 32, 765-73(1960) Dec. (In German)

The prospects for wider application of heavy water in atomic-energy production depend greatly on its price. A comparison of the various manufacturing processes and a discussion of their advantages and disadvantages show that distillation of liquid hydrogen and the exchange process are best suited for technical production. (auth)

7416 SEPARATION OF THE LANTHANONS AT AMALGAM CATHODES. IV. HIGH PURITY YTTERBIUM FROM MIXTURES OF HEAVY LANTHANONS BY AQUEOUS ELECTROLYSIS. E. I. Onstott (Los Alamos Scientific Lab., N. Mex.). J. Am. Chem. Soc. 82, 6297-9(1960) Dec. 20.

Ytterbium was separated from a mixture of heavy lanthanons by electrolysis into mercury from an aqueous lithium citrate electrolyte at pH 6. Enrichment of the Yb_2O_3 was from 31% to >99.9% purity and the yield was quantitative. A 50-50 mixture of ytterbium and radioactively tagged thulium was used to study the effect of pH on electrolysis rates and on the purity of electrolyzed ytterbium. A strong pH dependence was found with the rate of electrolysis of ytterbium being 40-fold slower at pH 11 than at pH 6. The average purity of ytterbium electrolyzed from the 50-50 mixture of Yb–Tm was 99.98% at pH 6 and 99.96% at pH 8. A foreign impurity effect was found (believed to be platinum contamination) which affected the rate of electrolysis of thulium, and for one experiment the rate for ytterbium was also affected. Since the effect was different for thulium and ytterbium the purity of the electrolyzed ytterbium was variant. (auth)

7417 RUTHENIUM VOLATILIZATION IN THE DISTILLATION OF NITRIC ACID. Archie S. Wilson (General Electric Co., Richland, Wash.). J. Chem. Eng. Data 5, 521-4(1960) Oct. (HW-SA-1794)

The experiments reported here were designed to examine some chemical factors which enhance ruthenium volatilization and to define distillation conditions which would suppress ruthenium volatilization. A modified Othmer equilibrium still was used in these experiments. Mild reducing agents such as $NaNO_2$, NO_2, and a mixture of tributyl phosphate and a hydrocarbon diluent, Soltrol-170, were found to suppress the ruthenium volatilization. In the presence of reducing agents, HNO_3 could be distilled from fission product wastes with volatilization factors as low as 10^{-6} and in the absence of the agents the factors were as high as 10^{-2}. Ruthenium volatilization is enhanced by increased acid concentration and long distillation times and occurs over the acid concentration range of 5 to 13 M. Spectrophotometric evidence indicates that the distilling ruthenium species is the tetroxide when air is excluded, and another species is collected when air is not excluded. (B.O.G.)

7418 ADSORPTION OF URANIUM FISSION PRODUCTS ON HUMIC ACID. R. Winkler (Zentralinstitut für Kernphysik, Rossendorf, Ger.) and E. Leibnitz. Kernenergie 3, 992-8(1960) Oct.-Nov. (In German)

Humic acid was separated from high moor peat and prepared in a solid and a colloidal solution form. A study was made of the adsorption of (S, Sr, and Ce^{3+} ions on both forms of humic acid with respect to dependence on contact time, cation concentration, pH, and temperature. For the cation pairs Cs/Ca, Sr/Ca, and Ce/Ca, selectivity coefficients were found. The distribution of cations between humic acid and the aqueous phase was determined by labeling with Cs^{137}, Sr^{90}, or Ce^{144}, and measuring the radioactivity in the liquid phase. The experiments give information on the exchange behavior of humic acid which is being considered as a polyfunctional weakly acid cation exchanger. On the basis of the results, the possibilities are discussed for purifying fission-product containing waste water with natural humic-acid containing exchangers such as peat or lignite. (tr-auth)

7419 SELECTIVE SEPARATION OF RADIOACTIVE STRONTIUM. K. H. Lieser and W. Hild (Technische Hochschule, Darmstadt, Ger.). Naturwissenschaften 47, 494-5(1960) Nov. (1). (In German)

In the investigation of heterogeneous isotope and ion exchange on solid alkaline earth sulfates, it was established that strontium ions were exchanged to a relatively large extent on solid barium sulfate. A barium sulfate preparation suitable for use in the exchange tube was prepared by two consecutive reactions with silica gel. The specific surface of the "barium sulfate" thus prepared is an order of magnitude greater than that of precipitated barium sulfate. This cation exchanger is highly selective. Isotopic cations were preferably exchanged. Research on the exchange column filled with this preparation gave very good results. Distilled water, Darmstadt tap water, and various solutions of variable compositions were tested in the column, using Sr^{89} or Sr^{90} as tracer. The strontium was completely removed from the tap water. (J.S.R.)

7420 PROGRESS IN TECHNOLOGY. 3. PROCESS CHEMISTRY. G. R. Hall (Imperial Coll. of Science and Tech., London). Nuclear Power 6, No. 57, 79-80(1961) Jan.

Some developments in the field of reactor-fuel processing are described, particularly with reference to power reactors. The following items are discussed: fuel processing for power reactors in U. S., Windscale second plant, second French plutonium separation plant for EDF reactor fuels, Eurochemic Plant of Belgium, Indian ore processing plant, U^{235} separation by gas centrifugation, and reactor chemistry. (D.L.C.)

7421 ULTRASONIC AIDED EXTRACTION OF URANIUM FROM ROCK. P. F. Andreev, E. M. Rogozina, and

Yu. M. Rogozin. Zhur. Fiz. Khim. 34, 2429-30(1960) Nov. (In Russian)

The extraction of uranium from rock under the action of ultrasonic waves of various frequencies was investigated. It was found that during irradiation a sodium solution extracts uranium from rock twice as completely and seven times as fast as during simple mixing. Increases in frequency of the ultrasonic vibrations lead to acceleration of the process and to increasing totality of extraction. (auth)

7422 EXTRACTION OF URANIUM FROM PHOSPHORIC ACID SOLUTIONS. B. N. Laskorin and V. F. Smirnov. Zhur. Priklad. Khim. 33, 2172-9(1960) Oct. (In Russian)

The phosphoric acid formed after treating uranium-bearing phosphate rocks with acids contains, in addition to uranium, impurities such as Ca, Fe, Al, and Si fluorides. The solutions have a high specific gravity, a low emf, and a tendency to form deposits upon standing. The usual extraction agents, such as ketones and simple esters cannot be used for extracting the uranium. It was found that single acid esters of ortho and pyrophosphoric acids and their mixtures with neutral esters are quite effective. For industrial application the ester of di-alkyl pyrophosphoric acid and mixtures of di-alkyl orthophosphoric esters with alkyl-dialkylphosphoric esters appear to be most promising. 21 references are given. (TTT)

7423 IMPROVEMENTS IN METHODS AND DEVICES FOR SEPARATING A GRANULAR MATERIAL FROM A LIQUID. Georges Cohen de Lara, Michel Louis Delachanal, and Roger Platzer (to Commissariat à l'Energie Atomique). British Patent 849,637. Sept. 28, 1960.

A method of obtaining a uniform and regular supply of granular material for continuous feed to another apparatus consists in feeding the material into a liquid of lower density than the material and passing a conveyor belt in the liquid upward at an angle just a little smaller than the angle of repose for the material in the liquid. In this way, when the belt speed is correct, a single continuous layer of material is carried out of the liquid by the belt. (D.L.C.)

7424 A PROCESS FOR SEPARATING THORIUM, CERIUM AND RARE EARTHS FROM MIXTURES OF THEIR OXIDES OR HYDROXIDES. Friedrich Gottdenker and Pawel Krumholz. British Patent 855,481. Nov. 30, 1960.

A simple economical method for separating cerium from thorium and rare earths is outlined in which the separation of cerium and thorium is accomplished after, and not prior to, the separation of rare earths from cerium. The method consists of oxidizing the cerium by heating in air, selectively dissolving the rare earths, dissolving the residue in acid under reducing conditions, and selectively precipitating the thorium with alkali. This method is especially useful for separating a mixture of hydroxides or oxides obtained by alkaline attack of monazite, and an example of this method is given using such a mixture. (D.L.C.)

7425 IMPROVEMENTS IN OR RELATING TO LIQUID–LIQUID EXTRACTION COLUMNS. Henry Reginald Clive Pratt and John Desmond Thornton (to United Kingdom Atomic Energy Authority). British Patent 855,963. Dec. 14, 1960.

A redistributor plate for liquid-liquid extraction columns incorporating sieve plates is designed to improve column efficiency and consists of a funnel-shaped member through which the continuous phase flows turbulently and an inverted annular channel member which causes the dispersed phase to mix with the continuous phase flowing through the funnel. The turbulence helps redistribute the continuous phase, thus preventing column efficiency reduction due to uneven concentration. (D.L.C.)

7426 A PROCESS FOR PREPARING HIGH-PURITY URANIUM VALUES FROM URANIUM ORE CONCENTRATES. (to Union Carbide Corp.). British Patent 856,827. Dec. 21, 1960.

High-purity uranium values may be prepared from uranium ore concentrates containing 70 to 85% U_3O_8 by dissolving the concentrates in a mineral acid under oxidizing conditions to give an aqueous solution of pH 0.1 to 3.0, extracting the uranium values from the aqueous solution with a solution of di(2-ethylhexyl) phosphoric acid in kerosene in such a manner that the organic phase is saturated with uranium, scrubbing the organic phase with dilute acid, and finally stripping the uranium from the organic phase. Possible ways of separating uranium from the strip solutions are described. Two examples of this method are given which resulted in uranium with impurity contents less than 0.01%. (D.L.C.)

7427 IMPROVED PROCESS FOR THE PURIFICATION OF URANIUM SALTS. Egon Bretscher, Norman Feather, Hans Heinrich von Halban, and Lew Kowarski (to United Kingdom Atomic Energy Authority). British Patent 856,921. Dec. 21, 1960.

Uranium nitrate or some other uranium salt soluble in organic solvents may be purified readily by dissolving in an organic solvent and adding a displacer to form an aqueous layer containing the bulk of the impurities. Suitable organic solvents are methyl ethyl ketone (preferred), acetone, ethyl and methyl alcohols, ether, and cyclohexanone. Suitable displacers are xylene (preferred), benzene, toluene, cymene, tetraline, chlorobenzene, nitrobenzene, and carbon tetrachloride. (D.L.C.)

7428 METHOD OF SEPARATING FISSILE MATERIAL. Kurt Diebner. British Patent 858,094. Jan. 4, 1961.

A method of separating plutonium or U^{233} which has been formed in a fuel element by neutron capture by U^{238} or thorium, respectively, is described which simply consists of scraping a layer ~0.01 cm thick from the fuel element and then subjecting this layer to known extraction procedures. The effectiveness of this method resides in the falling off of the neutron flux inside the fuel element and is increased by increasing the surface area-volume ratio of the element and the conversion factor. Plots of the per cent plutonium carried by the 0.01-cm layer vs. half-thickness or radius are given for plates and cylinders at three different conversion factors. (D.L.C.)

7429 IMPROVEMENTS IN OR RELATING TO CHEMICAL PROCESS VESSELS CONTAINING FISSIONABLE MATERIAL. Horace Frank Parker (to United Kingdom Atomic Energy Authority). British Patent 859,020. Jan. 18, 1961.

A process vessel is designed which is suitable for dissolving large quantities of fissionable material efficiently without occurrence of supercritical conditions. The vessel comprises a cylindrical container and a slab-like tank connected with each other by pipes and designed with safe dimensions. The cylindrical container has inlets, a steam jacket, and a condenser so that a convection circulation can be set up which is excellent for dissolving irradiated uranium fuel members in acid. (D.L.C.)

7430 PROCESS FOR SEPARATING PLUTONIUM BY HYDROXIDES. (to United Kingdom Atomic Energy Authority). British Patent 859,191. Jan. 18, 1961.

A carrier process for separating plutonium from solu-

tions of irradiated uranium is outlined which results in reduction of carrier bulk and liquid volumes. In this process, which is preferably preceded by a bismuth phosphate precipitation, a soluble salt of a carrier metal is added to the nitric acid solution to give a concentration of 50 to 500 mg/l, the solution is made neutral or slightly alkaline, the plutonium-carrying precipitate is removed and then redissolved, and the process repeated with a second metal salt. The carrier metal may be one of the group Al, Bi, Cu, Co, Fe, La, Ni, and Zr. The plutonium may be in either the reduced or oxidized form. (D.L.C.)

7431 PROCESSING OF NEUTRON-IRRADIATED URANIUM. H. H. Hopkins, Jr. (to U. S. Atomic Energy Commission). U. S. Patent 2,951,740. Sept. 6, 1960.

An improved "Purex" process for separating uranium, plutonium, and fission products from nitric acid solutions of neutron-irradiated uranium is offered. Uranium is first extracted into tributyl phosphate (TBP) away from plutonium and fission products after adjustment of the acidity from 0.3 to 0.5 M and heating from 60 to 70°C. Coextracted plutonium, ruthenium, and fission products are fractionally removed from the TBP by three scrubbing steps with a 0.5 M nitric acid solution of ferrous sulfamate (FSA), from 3.5 to 5 M nitric acid, and water, respectively, and the purified uranium is finally recovered from the TBP by precipitation with an aqueous solution of oxalic acid. The plutonium in the 0.3 to 0.5 M acid solution is oxidized to the tetravalent state with sodium nitrite and extracted into TBP containing a small amount of dibutyl phosphate (DBP). Plutonium is then back-extracted from the TBP–DBP mixture with a nitric acid solution of FSA, reoxidized with sodium nitrite in the aqueous strip solution obtained, and once more extracted with TBP alone. Finally the plutonium is stripped from the TBP with dilute acid, and a portion of the strip solution thus obtained is recycled into the TBP–DBP for further purification.

7432 ELECTROLYSIS OF THORIUM AND URANIUM. Wilford N. Hansen (to U. S. Atomic Energy Commission). U. S. Patent 2,951,793. Sept. 6, 1960.

An electrolytic method is given for obtaining pure thorium, uranium, and thorium-uranium alloys. The electrolytic cell comprises a cathode composed of a metal selected from the class consisting of zinc, cadmium, tin, lead, antimony, and bismuth, an anode composed of at least one of the metals selected from the group consisting of thorium and uranium in an impure state, and an electrolyte composed of a fused salt containing at least one of the salts of the metals selected from the class consisting of thorium, uranium, zinc, cadmium, tin, lead, antimony, and bismuth. Electrolysis of the fused salt while the cathode is maintained in the molten condition deposits thorium, uranium, or thorium–uranium alloys in pure form in the molten cathode which thereafter may be separated from the molten cathode product by distillation.

7433 SEPARATION OF PLUTONIUM VALUES FROM URANIUM AND FISSION PRODUCT VALUES. A. G. Maddock and A. H. Booth (to U. S. Atomic Energy Commission). U. S. Patent 2,952,511. Sept. 13, 1960.

Separation of plutonium present in small amounts from neutron irradiated uranium by making use of the phenomenon of chemisorption is described. Plutonium in the tetravalent state is chemically absorbed on a fluoride in solid form. The steps for the separation comprise dissolving the irradiated uranium in nitric acid, oxidizing the plutonium in the resulting solution to the hexavalent state, adding to the solution a soluble calcium salt which by the common ion effect inhibits dissolution of the fluoride by the solution, passing the solution through a bed or column of subdivided calcium fluoride which has been sintered to about 800°C to remove the chemisorbable fission products, reducing the plutonium in the solution thus obtained to the tetravalent state, and again passing the solution through a similar bed or column of calcium fluoride to selectively absorb the plutonium, which may then be recovered by treating the calcium fluoride with a solution of ammonium oxalate.

7434 CESIUM RECOVERY FROM AQUEOUS SOLUTIONS. C. A. Goodall (to U. S. Atomic Energy Commission). U. S. Patent 2,952,640. Sept. 13, 1960.

A process is given for precipitating cesium on zinc ferricyanide (at least 0.0004 M) from aqueous solutions containing mineral acid in a concentration of from 0.2 N acidity to 0.61 N acid-deficiency and advantageously, but not necessarily, also aluminum nitrate in a concentration of from 1 to 2.5 M.

7435 STRONTIUM PRECIPITATION. T. R. McKenzie (to U. S. Atomic Energy Commission). U. S. Patent 2,952,641. Sept. 13, 1960.

A process is given for improving the precipitation of strontium from an aqueous phosphoric-acid-containing solution with nickel or cobalt ferrocyanide by simultaneously precipitating strontium or calcium phosphate. This is accomplished by adding to the ferrocyanide-containing solution calcium or strontium nitrate in a quantity to yield a concentration of from 0.004 to 0.03 and adjusting the pH of the solution to a value of above 8.

7436 PROCESS OF ELIMINATING HYDROGEN PEROXIDE IN SOLUTIONS CONTAINING PLUTONIUM VALUES. J. G. Barrick and B. A. Fries (to U. S. Atomic Energy Commission). U. S. Patent 2,954,273. Sept. 27, 1960.

A procedure is given for peroxide precipitation processes for separating and recovering plutonium values contained in an aqueous solution. When plutonium peroxide is precipitated from an aqueous solution, the supernatant contains appreciable quantities of plutonium and peroxide. It is desirable to process this solution further to recover plutonium contained therein, but the presence of the peroxide introduces difficulties; residual hydrogen peroxide contained in the supernatant solution is eliminated by adding a nitrite or a sulfite to this solution.

7437 SEPARATION OF RARE EARTHS BY SOLVENT EXTRACTION. D. F. Peppard and G. W. Mason (to U. S. Atomic Energy Commission). U. S. Patent 2,955,913. Oct. 11, 1960.

A process is given for separating lanthanide rare earths from each other from an aqueous mineral acid solution, e.g., hydrochloric or nitric acid of a concentration of above 3 M, preferably 12 to 16 M, by extraction with a water-immiscible alkyl phosphate, such as tributyl phosphate or a mixture of mono-, di- and tributyl phosphate, and fractional back-extraction with mineral acid whereby the lanthanides are taken up by the acid in the order of increasing atomic number.

7438 METHOD OF SEPARATING RARE EARTHS BY ION EXCHANGE. F. H. Spedding and J. E. Powell (to U. S. Atomic Energy Commission). U. S. Patent 2,956,858. Oct. 18, 1960.

A process is given for separating yttrium and rare earth values having atomic numbers of from 57 through 60 and 68 through 71 from an aqueous solution whose pH value can range from 1 to 9. All rare earths and yttrium are first adsorbed on a cation exchange resin, and they

are then eluted with a solution of N-hydroxyethylethylenediaminetriacetic acid (HEDTA) in the order of decreasing atomic number, yttrium behaving like element 61; the effluents are collected in fractions. The HEDTA is recovered by elution with ammonia solution and the resin is regenerated with sulfuric acid. Rare earths are precipitated from the various effluents with oxalic acid, and each supernatant is passed over cation exchange resin for adsorption of HEDTA and nonprecipitated rare earths; the oxalic acid is not retained by the resin.

7439 SEPARATION OF RUTHENIUM COMPOUNDS FROM GASEOUS MIXTURES. B. J. Newby, D. A. Hanson, and C. E. May (to U. S. Atomic Energy Commission). U. S. Patent 2,964,130. Dec. 13, 1960.

A process is given for removing RuO_4 from waste calcination off-gases by adsorption on silica gel, preferably of from 70 to 80°C. The RuO_4 can be eluted from the silica gel with water of a temperature between 60 and 70°C.

7440 RECOVERY OF RUTHENIUM VALUES. W. E. Grummitt and W. H. Hardwick (to U. S. Atomic Energy Commission). U. S. Patent 2,967,209. Jan. 3, 1961.

A process is given for the recovery of ruthenium from its aqueous solutions by oxidizing the ruthenium to the octavalent state and subsequently extracting the ruthenium into a halogen-substituted liquid paraffin.

7441 SEPARATION OF PLUTONIUM IONS FROM SOLUTION BY ADSORPTION ON ZIRCONIUM PYROPHOSPHATE. R. W. Stoughton (to U. S. Atomic Energy Commission). U. S. Patent 2,970,035. Jan. 31, 1961.

A method is given for separating plutonium in its reduced, phosphate-insoluble state from other substances. It involves contacting a solution containing the plutonium with granular zirconium pyrophosphate.

7442 PROCESS FOR REMOVING NOBLE METALS FROM URANIUM. J. B. Knighton (to U. S. Atomic Energy Commission). U. S. Patent 2,970,050. Jan. 31, 1961.

A pyrometallurgical method is given for purifying uranium containing ruthenium and palladium. The uranium is disintegrated and oxidized by exposure to air and then the ruthenium and palladium are extracted from the uranium with molten zinc.

ENGINEERING AND EQUIPMENT

General and Miscellaneous

7443 (HW-67257) STRESSES PRODUCED IN REMOTE STUDS BY IMPACT AND SLOWLY APPLIED TIGHTENING TORQUE. K. L. Pell and N. H. Shoup (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Apr. 1958. 62p. Contract AT(45-1)-1350. OTS.

A series of tests was proposed to make a quantitative study of the relationships between tightening torque and the actual stresses induced in a stud. Variables of stud-material hardness, type of nut face, lubrication, and induced bending of the stud were introduced in two series of tests. The first series of tests was made with a slowly applied torque; in the second series of tests an impact wrench was used in the tightening operation. (W.L.H.)

7444 (KAPL-M-EC-1) STEADY STATE NATURAL CIRCULATION STEAM GENERATOR SIZING PROGRAM. D. G. Dight and C. J. Meyer (Knolls Atomic Power Lab., Schenectady, N. Y.). Sept. 19, 1960. 35p. Contract W-31-109-Eng-52. OTS.

A Philco 2000 digital computer program which aids in the design of natural circulation steam generators is presented. The solution entails finding the two-phase circulation ratio and the steam drum water level at various percentages of power. The equations were kept as general as possible, i.e., a particular system geometry was not specified, in order that the program could be used for both optimum sizing in preliminary plant arrangement studies and for confirmatory calculations of future vendor performance specifications. (auth)

7445 (NAA-SR-5275) THERMAL CYCLING AND LEAKAGE TESTS OF 2-IN. VALVES FOR SODIUM SERVICE. C. J. Baroczy (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Dec. 1, 1960. 28p. Contract AT(11-1)-GEN-8.

Tests were performed to determine the effect of thermal cycling on the across-the-seat leakage characteristics of valves considered for use in the auxiliary coolant system of the Hallam Nuclear Power Facility. Twelve 2-in. valves were thermally cycled in a sodium loop between 300 and 650°F and periodically tested for across-the-seat sodium leakage. Five different valve types, representing eight manufacturers, were sodium-leak tested at pressure differentials of 10 to 30 psi, and temperatures of 395 to 685°F. Five bellows-seal globe valves had a leakage pattern which indicated a maximum leakage rate at a pressure differential of 20 psi. The torque-tube valve had considerable leakage in some tests caused by inconsistent valve closing. A freeze-seat valve, a solenoid valve, and four flexible-seat valves had no leakage. The flexible-seat valves were particularly easy to open and close. No valve-stem sodium leakage was observed for any of the valves tested. (auth)

7446 (NAA-SR-5463) THE SELECTION, DESIGN MODIFICATION, AND ANALYSIS OF SODIUM VALVES FOR HALLAM NUCLEAR POWER FACILITY. B. Brooks, R. Galantine, and F. Bergonzoli (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Dec. 1, 1960. 40p. Contract AT(11-1)-GEN-8.

Various valves were selected and modified for use in the HNPF prototype valve test program. The valves selected are of basically commercial design; modifications include the incorporation of a liquid-cooled stem freeze seal device. Results of the testing of the valves are considered very satisfactory except in the area of across-the-seat leakage of the prototype for the primary throttling valves. As described in the final specifications, the valves to be installed at HNPF are essentially identical to the prototype units except that a modification of the valve seat geometry of the throttling valves was incorporated to minimize seat leakage. The freeze seal cooling medium was changed from liquid to gas. Analysis of the respective drawings verified the design and structural criteria of the various valves. (auth)

7447 (NYO-2902) ULTRAHIGH VACUUM TECHNIQUES. Quarterly Progress Report for July 1–September 30, 1960. Research Report 403FF466-1-R3. (Westinghouse Electric Corp. Research Labs., Pittsburgh). Nov. 28, 1960. 14p. Contract AT(30-1)-2176.

In vacuum component studies, Monel against Monel was found to give the most consistent and tightest valve closures. Testing of teflon against steel for use in valves is in progress. The effectiveness of zeolite traps in isolating systems using various pump fluids is being studied; initial results indicate a wide range of effective trapping. A small bakeable mass spectrometer was developed and is being used in the zeolite trap studies. Investigations of hydrogen

nteraction with hot tungsten were continued. The observed rate of pressure change is apparently associated with vacuum system wall coverage changes. Experiments are under way to measure this effect. The recovery of noble gases, previously pumped ionically into molybdenum, by r-f heating of this metal, is being studied. Data for argon as the pumped gas are presented graphically. (J.R.D.)

7448 (NYO-9376) AN EVALUATION OF TIME-DEPENDENT, MATERIALS INFORMATION FOR PURPOSES OF PRESSURE VESSEL DESIGN AND ANALYSIS. Final Report, Phase I, Task II. L. U. Rastrelli (Southwest Research Inst., San Antonio). July 1, 1960. 244p. Project 774-2-B. Contract AT(30-1)-2146.

The materials information currently available in the literature which, in one form or another, attempts to depict the behavior of materials in a time-dependent environment was evaluated in terms of its applicability to the rational design and analysis of nuclear power plant pressure vessels. It was found that the existing information is inadequate for the following reasons: (a) There is little similarity between the test histories used in the majority of investigations and the service history one may expect for a pressure vessel. (b) The materials hypotheses suggested for predicting the behavior of a material in a varying amplitude cyclic load history fail to show any reasonable degree of correlation between theory and experiment. (c) The hypotheses, if used in the analysis of pressure-vessel materials, in general yield conservative results. (d) The materials hypotheses' equations are not conducive to the development of a rational method of structural analysis for pressure vessels, their usefulness being limited to comparing the fatigue life of one material with another. (e) The concepts of fatigue damage and damage accumulation as currently presented in the literature are abstractions that are not defined quantitatively and as such are not conducive to forming the equations necessary in any rational design procedure. (f) The controlled-strain type of histories used in "low" cycle fatigue tests are more in keeping, on the basis of time, with the actual service history of a pressure vessel. However, these existing test data merely replace the "stress versus number-of-cycles-to-failure" curves acquired from constant load amplitude tests, with "strain versus number-of-cycles-to-failure" curves acquired from constant strain amplitude tests, and as such, their usefulness is also limited to comparing one material's fatigue life with another. In the former, no information is given with regard to the specimen's deformations during the history, while in the latter tests, no information is acquired to denote the variations in the applied load. (g) Data depicting the behavior of materials when subjected to cyclic load conditions and elevated temperature environments (either steady-state or intermittent) are, at best, perfunctory and uncoordinated either with respect to related investigations or the actual service conditions. The degree of dissimilarity is primarily due to the fact that careful consideration is not given to the extreme sensitivity of the experimental variable's time dependent changes. (auth)

7449 (SCTM-335-60(14)) PREDICTION OF SHOCK RESPONSE. Peter M. Barba (Sandia Corp., Albuquerque, N. Mex.). Nov. 1960. 19p.

A method is presented for predicting the shock response of a friction-damped vibratory system. A single-degree-of-freedom dry-friction-damped system is used as a model to write the differential equation. The unknown coefficients of the equation are determined by a trial-and-error process. The measured input to an actual physical system is used as an input for the differential equation, and the computed output is compared to the measured output. The coefficients are adjusted until the computed output matches the measured output. The Lamoen phase plane construction is used for the solution of the differential equation. The phase plane results are compared to an analog computer solution of the same equation. (auth)

7450 (TID-11397) DRY BEARING ENDURANCE TEST FOR THE SERVICE MACHINE: EXPERIMENTAL GAS-COOLED REACTOR. B. H. Flippen (Allis-Chalmers Mfg. Co. Atomic Energy Div., Washington, D. C.). Sept. 29, 1960. 8p. Contract AT(10-1)-925. (RD-0300). OTS.

The concept of operating bearings and gears unlubricated in a helium environment was questioned as to fundamental soundness. Tests were made to determine if immediate gross failure occurs. A bearing of standard manufacture was operated in helium for 42 hr. A high degree of gradual wear was encountered. No gross or sudden failures were found. (W.L.H.)

7451 (UCRL-6113) A LIQUID-HELIUM-COOLED TRAP FOR PUMPING GAS BY ADSORPTION. G. Gibson, W. C. Jordan, E. J. Lauer, and J. R. Ullman (California. Univ., Livermore. Lawrence Radiation Lab.). Oct. 1960. 22p. Contract W-7405-eng-48.

An apparatus was tested in which two vacuum chambers are connected by a cylindrical hole (2.54 cm in diameter and 50.8 cm long) formed in degassed charcoal that is cooled to the temperature of liquid helium. Portions of the two vacuum chambers are also at or near to liquid-helium temperature. When a hydrogen leak into one chamber was turned on at a rate (0.5 μl/sec), which resulted in a steady pressure of about 5×10^{-6} mm Hg, the pressure in the chamber connected to the opposite end of the tube did not rise significantly above the base pressure ($\sim 1.5 \times 10^{-8}$ mm Hg) for 75 minutes. When the leak rate was increased by a factor of nine, the time delay before the pressure rise was decreased by a factor of about nine. No delay was observed when the charcoal was at liquid-nitrogen temperature. (auth)

7452 (UCRL-6249-T) DISTRIBUTION OF RADIOACTIVITY FROM A NUCLEAR EXCAVATION. Roger E. Batzel (California. Univ., Livermore. Lawrence Radiation Lab.). Oct. 26, 1960. 18p. Contract W-7405-eng-48.

There are two sources of radioactivity from a nuclear explosion. One is the radioactivities (fission products and tritium) which are direct products of the nuclear reactions, and the second source is radioactivity induced in the surrounding medium by the neutrons which are by-products of the nuclear explosion. The distribution of radioactivity from the proposed Chariot excavation experiment can be predicted on the basis of data from past excavation experiments. (auth)

7453 A HIGH-VOLTAGE AND RAY-PROOF ROENTGEN EQUIPMENT FOR IRRADIATION OF SMALL AND MEDIUM-SIZED OBJECTS. R. Thoraeus (Inst. of Radiophysics, King Gustav V. Jubilee Clinic, and Karolinska Sjukhuset, Stockholm). Acta Radiol. 54, 483-8(1960) Dec. (In English)

A compact high-voltage ray-proof apparatus for the roentgen irradiation of small and medium-sized objects such as animals is described. (auth)

7454 THIN TUBE PLATES FOR H.P. HEAT EXCHANGERS. D. E. Hartley (Queen Mary College, London). Nuclear Eng. 5, 557-60(1960) Dec.

Stress analysis is carried out for a tube heat exchanger

with two thin tube plates. It is shown that, when a tube plate is sufficiently flexible, the bending in it is restricted to the outer rows of tubes with the main central area of the plate remaining flat. Considerations involved in designing a heat exchanger with 217 tubes and 1000-psi pressure are discussed. (D.L.C.)

7455 A SYSTEMS ANALYSIS OF FAST MANNED FLIGHTS TO VENUS AND MARS. PART I. MISSION PHILOSOPHY, LIFE SUPPORT, SCIENTIFIC RECONNAISSANCE, AND PROTOTYPE VEHICLE LAYOUT. Krafft A. Ehricke (Convair, San Diego, Calif.). Paper No. 60-Av-1. New York, American Society of Mechanical Engineers, 1960. 12p.

A report is given of a systems analysis of the initial phase of manned interplanetary operations. The primary objectives of the first missions are specified, and the mission philosophy is discussed in order to set a frame of reference. The importance of brief mission periods is emphasized. Suitable mission profiles to Mars and Venus are presented. A discussion of propulsion systems, which can be expected to be available at that time, leads to the conclusion that the nuclear heat exchanger system, operating with liquid hydrogen, offers the best compromise within the framework of the mission philosophy outlined. The requirements for the ecological payload and the supporting systems are discussed, and the resulting weight requirements for the life support system and the scientific payload are determined. A prototype layout for fast-manned reconnaissance vehicles is presented. The principal conclusions are summarized. (auth)

7456 A SYSTEMS ANALYSIS OF FAST MANNED FLIGHTS TO VENUS AND MARS. PART II. STORAGE OF LIQUID AND SOLID HYDROGEN ON NUCLEAR POWERED INTERPLANETARY VEHICLES. Krafft A. Ehricke (Convair, San Diego, Calif.). [New York, American Society of Mechanical Engineers, 1960.] 22p.

A description is given of the methods to be used in the storage of hydrogen in the proposed space vehicle for fast manned flight to Mars and Venus. The essential result is that long-term storage of hydrogen in quantities and for time periods as required for fast interplanetary missions with nuclear powered vehicles with a specific impulse of 800 to 900 sec is a fairly straight-forward engineering problem. The problem lends itself to several solutions whose relative attractiveness depends on special mission conditions. One of the most potent means of assuming long-term storage with virtually no losses is the combination of reflector shielding and a spaceborne hydrogen liquefaction unit. A broad study of cryogenic storage problems in space indicates four principal approaches: attitude control, reflector shielding, freezing (static heat sink method), and refrigeration (dynamic heat sink method). Discussions concerning reflection shielding calculations, heat conductivity between reflector layers kept apart by small ribs, configuration factors, radiation from a distant reflector shield, Stirling cycle refrigerator engines, and the reflectivity, absorptivity, and emissivity of metal foils or metal coatings for reflector shields are appended. (B.O.G.)

7457 SIXTH NATIONAL SYMPOSIUM ON VACUUM TECHNOLOGY; TRANSACTIONS, OCTOBER 7, 8, AND 9, 1959, PHILADELPHIA, PENNSYLVANIA. Also Cumulative Index of 1954–1959 Symposia. New York, Pergamon Press Inc., 1959. 346p. $17.50.

Included are 58 papers grouped into the following categories: The Role of Spectroscopy in Vacuum Science; High and Ultra-high Vacuum Systems; Vacuum Measuring Techniques; Vacuum System Applications; Applications of Vacuum in Science; Thin Films and Vaporizing Sources; Vacuum System Components; and Ionic Pumping. A cumulative index is given of the papers and authors for the Symposia from 1954 to 1959. Separate abstracts were prepared for eighteen papers. (B.O.G.)

7458 THE PRODUCTION OF ULTRA-HIGH VACUUM IN METAL SYSTEMS LARGER THAN ONE THOUSAND LITERS. I. Farkass and G. F. Vanderschmidt (National Research Corp., Cambridge, Mass.). p.42-7 of "Sixth National Symposium on Vacuum Technology; Transactions."

Methods for the production of a pressure of 10^{-9} mm Hg in metal vacuum chambers of volumes greater than 1000 liters are described. The following pumping methods are theoretically analyzed: mechanical pumps, getter pumps, ion-getter pumps, diffusion pump-trap systems, and cryogenic pumps. Experimental results on these pumping methods are presented; the conclusion of theory and experiment is that the best method for pumping large chambers to 10^{-9} mm Hg is the diffusion pump and trap system. Promising supplementary methods are cryogenic pumping and getter pumping. Seals for use in large metal systems are described; the seals include metal gasket compression seals useful to 6-in. diameter, large semipermanent seals, and large (4-ft diameter) easily opened and closed seals. (auth)

7459 AN ULTRA-HIGH-VACUUM CHAMBER FOR SPACE SIMULATION. John C. Simons, Jr. (National Research Corp., Cambridge, Mass.). p.48-54 of "Sixth National Symposium on Vacuum Technology; Transactions."

Criteria for large ultra-high-vacuum systems, particularly for space simulation applications, are reviewed. Physics and engineering problems faced in the design of such equipment are considered and a design approach formulated. A 40 ft^3 vacuum chamber designed by this method to operate at 10^{-9} mm Hg is described. This facility has been built and is operating in the NRC research laboratories. The pumping system consists of a 10 in. oil diffusion pump, a water-cooled baffle, and two liquid nitrogen cooled traps in series. The chamber itself is $3\frac{1}{2}$ ft in diameter and is made of stainless steel. A removable door forms one end of the chamber. Results obtained from experimental operation of the chamber are described. Engineering and economic compromises necessary in the design of still larger ultra-high-vacuum facilities (for example, 1000 ft^3 volume) are discussed. Design recommendations for a large system are made. (auth)

7460 A DIFFERENTIALLY PUMPED ULTRA-HIGH VACUUM SYSTEM. M. Rivera and R. Le Riche (New York Air Brake Co., Camden, N. J.). p.55-9 of "Sixth National Symposium on Vacuum Technology; Transactions."

A differentially pumped ultra-high vacuum system of nominal size is described. The system is cycled by baking for 10 hr and cooling for 5 hr; pressures in the range of 1 and 2×10^{-9} mm Hg are attained routinely. The design features of an ultra-high vacuum system are given, as well as the theoretical basis for a differentially pumped system. The operation of the unit is described and the results presented. (auth)

7461 ULTRA-HIGH-VACUUM PUMPING BY VIBRATING MEMBRANE. H. Schwarz (Radio Corp. of America, Somerville, N. J.). p.60-5 of "Sixth National Symposium on Vacuum Technology; Transactions."

A radically new type of noncontaminating ultra-high-vacuum pump has been proposed. A diaphragm or membrane is driven into high-frequency vibration so as to drive gas molecules selectively in a particular direction,

e., perpendicular to the diaphragm surface. Analysis has hown that, as the membrane peak velocity exceeds the ean thermal velocity of the gas molecules, the speed of pump, in which the membrane and openings have special eometries should approach the theoretical maximum. hus, the pump, if operated in conjunction with conventional umps to maintain a low forepressure, potentially could ap- roach an ideal one-way valve. Since the thermal velocities f molecules decrease with molecular weight, the pump hould be increasingly effective for heavier gases. The de- ice can also be used for separation of gaseous isotopes. auth)

462 DIFFUSION PUMP AND BAFFLE SYSTEMS OF ARGE SUCTION SPEEDS FOR PRESSURES LOWER HAN 10^{-8} TORR. H. B. Nöller, G. Reich, and W. Bächler E. Leybold's Nachfolger, Cologne, Germany). p.72-4 of Sixth National Symposium on Vacuum Technology; Trans- ctions."

A description is given of a pump and baffle system for he production of pressures lower than 10^{-8} Torr with good uction speeds at 10^{-9} to 10^{-10} Torr. Diffusion pumps hold romise of being suitable for the system because their orking principle is not dependent upon the pressure of he gases to be removed. The system incorporates an oil- iffusion pump, a water-cooled baffle, a baffle cooled by iquid nitrogen, a container, and a two-stage gas ballast ump. Graphical representations are given of the results or: high vacuum as a function of fore-pressure for various eater powers for hydrogen; and pumping speed as a func- ion of partial pressure for inlet gas with baffle and cold rap for air and hydrogen. The ultimate vacuum attainable s limited by outgassing from the walls, by the vapor pres- ure of the pump fluid, and possibly by breakdown products f the pump fluid. (B.O.G.)

463 RELATIONS BETWEEN SIZE OF VACUUM HAMBER, OUTGASSING RATE, AND REQUIRED PUMP- NG SPEED. B. B. Dayton (Consolidated Vacuum Corp., ochester, N. Y.). p.101-19 of "Sixth National Symposium n Vacuum Technology; Transactions."

A survey was made of the relations existing between out- assing rate, pumping speed, and chamber size for the roduction of a vacuum. Data are tabulated for: permea- ility coefficients for gases through nonmetallic materials; iffusion coefficients for gases through metals; constants or permeability of metals by gases; solubility coefficients or gases in solids; diffusion coefficients for gases through onmetallic materials; constants for permeation and diffu- ion of gases through nonmetallic materials; and outgassing ate constants for metallic materials. 45 references. B.O.G.)

464 RELATIONSHIP OF DIFFUSION PUMP PER- ORMANCE TO THE THERMODYNAMICS OF THE PUMP- NG FLUID. H. R. Smith (Lawrence Radiation Laboratory, niv. of California, Berkeley). p.140-5 of "Sixth National ymposium on Vacuum Technology; Transactions." (UCRL- 970)

Theoretical consideration of the thermodynamics of the rocesses occurring in the pump fluid of a diffusion pump as contributed to the understanding of pump operation. Many of the anomalous results observed by experimenters n this field can be clarified when analyzed from the ther- nodynamic point of view. Preliminary experimental data ave confirmed the validity of the theoretical reasoning. Application of the fundamental thermodynamic principles to ypical diffusion pumps has markedly improved perform- nce with regard to pumping speed, ultimate base pressure, nd fore-pressure tolerance. Detailed experimental results are presented. Promising possibilities for extension of this work and further improvement in pump design and perform- ance are discussed. (auth)

7465 RESULTS WITH ULTRA-HIGH VACUUM METAL SYSTEM INCLUDING WINDOWS, EVAPORATORS AND LEAD-INS. H. Ehlers and J. Moll (Leybold-Hochvakuum-Anlagen G.M.B.H., Cologne, Germany). p.261-4 of "Sixth National Symposium on Vacuum Technology; Transactions."

In the work described, it was necessary to obtain a pres- sure in the range from 10^{-8} to 10^{-10} mm Hg in metal con- tainers several liters to some thousands of liters in volume. A description is given of the experimental set-up and the evacuation process. The experience gained by the various tests show the ultra-high vacuum (u.h.v.) ultimate pressure measured by (1) one "nude" triode system (Ley- bold JM-2), and (2) one triode with glass jacket and an opening of ~17-mm diameter (Leybold JM-10), which gave ultimate pressures of 3×10^{-9} mm Hg and 5×10^{-10} mm Hg, respectively. Diagrams are given showing the metal seals used for flange connections, feed-throughs, and windows. Some of the experiences gained for the coating process in the u.h.v. are discussed. (B.O.G.)

7466 ULTRA-LOW TEMPERATURE MECHANICAL REFRIGERATION SYSTEMS FOR HIGH-VACUUM TRAPS AND BAFFLES. H. R. Smith and P. B. Kennedy (Lawrence Radiation Lab., Univ. of California, Berkeley, Calif.). p.271-7 of "Sixth National Symposium on Vacuum Tech- nology; Transactions." (UCRL-8920)

A description is given of practical methods of designing and operating mechanical refrigeration systems within the framework of commercially available components and re- frigerants. Several types of systems used to attain ultra- low temperatures are discussed, of which the cascade system is the usual approach. The components of the refrigeration system and the operating procedures are described. Probably the most important problems asso- ciated with the types of installations described, are leak tightness, separation of compressor crankcase oil from the gaseous refrigerant, and refrigerant flow control. A refrigeration cost comparison is given for the compound cascade, cascade, primary, and liquid nitrogen systems. (B.O.G.)

7467 SOME STUDIES OF GETTER-ION PUMPED VACUUM SYSTEMS. I. Ames and R. L. Christensen (IBM Research Lab., Poughkeepsie, N. Y.). p.311-16 of "Sixth National Symposium on Vacuum Technology; Transactions."

Vacuum phenomena in several small bakeable glass– metal systems, evacuated by getter-ion pumps, have been investigated. The systems were evacuated by various com- binations of water-aspiration, cryogenic pumping, and getter-ion pumping. Various degrees of baking were em- ployed. These ranged from heating of localized portions, through mild baking of the entire system while at the "fore" pressure of the liquid helium pump, to hard baking at high vacuum. The composition and behavior of the residual gases were examined by means of an omegatron. (auth)

7468 RECENT INFORMATION ON THE GETTERING OF GASES BY BARIUM FILMS. Paolo Della Porta (Get- ters Electronics Inc., Niagara Falls, N. Y. and S.A.E.S. Getters Research Lab., Milan, Italy). p.317-24 of "Sixth National Symposium on Vacuum Technology Transactions."

The apparatus and techniques used to study gettering by evaporated barium films are described. Particular atten- tion is given to the influence of ionizing currents and hot filaments. Results obtained for H_2, N_2, and CO, are com- pared. The various processes which contribute to the com-

plex sorption phenomena are indicated. It would appear that parallel mechanisms control the sorption of different gases by barium films. Data are given on the mobility of molecules of different gases on the surface and within the film. (auth)

7469 A SYSTEM OF CONVEYING LIQUIDS OR MIXTURES OF LIQUIDS. Jiri Drasky. British Patent 848,572. Sept. 21, 1960.

A system for conveying liquid metals and radioactive liquids without the disadvantages of mechanical and electromagnetic pumps is described in which the vapors of the liquid are used to drive an injector-type pump in the circuit. Three configurations of the system are described for a liquid-metal-cooled reactor using a mixture of two metals with different boiling points (miscible and immiscible) and for pumping radioactive liquids from one container to another. (D.L.C.)

7470 IMPROVEMENTS RELATING TO WEIGHT COUNTER-BALANCING APPARATUS. Walter John McKelliget (to Metropolitan-Vickers Electrical Co., Ltd.). British Patent 856,065. Dec. 14, 1960.

A weight counter-balancing system for teletherapy radiation sources rotating on annular members is designed so that radial movement of the source to or away from the rotation axis effects, via a linkage system, coaxial movement of two counter weights so that the counter balance is maintained. With this system, the source distance from the patient can easily be varied. Drawings are included. (D.L.C.)

7471 IMPROVEMENTS RELATING TO SEALS FOR PRESSURE VESSELS. Dennis Surridge Morfey (to British Thomson-Houston Co., Ltd.). British Patent 856,952. Dec. 21, 1960.

A seal of the same type as the ordinary ring seal but without a tendency to leak is designed comprising a T-shaped groove in the closure member and a resilient ring or gasket formed with lateral ears whereby it is retained in the groove. The gas pressure forces the ring into intimate contact with one side of the groove to form a good seal. (D.L.C.)

7472 IMPROVEMENTS IN OR RELATING TO VALVED DUCTING. George Blackburn and Vernon Morgan (to United Kingdom Atomic Energy Authority). British Patent 857,528. Dec. 29, 1960.

A valved coaxial duct for fluid flow between a heat exchanger and a heat source, e.g., a nuclear reactor, is designed with the inner pipe passing hot fluid into the exchanger and the annulus between the pipes leading cool fluid out. Butterfly valves are disposed in both hot and cool fluid flows. The inner pipe is insulated from the outer pipe to minimize heat loss. The coaxial design simplifies thermal expansion and contraction problems, and the position of the valves minimizes their possible distortion by thermal changes. (D.L.C.)

7473 IMPROVEMENTS IN RADIOACTIVE HANDLING PLANT. James Miller Nicol, John Arthur Young, and Tadeusz Zenon Jakobek (to Babcock and Wilcox Ltd.). British Patent 857,558. Dec. 29, 1960.

A materials handling plant for moving a radioactive charge between upper and lower stations is designed, comprising a hoist with a carriage running on tracks within a biological shield and an auxiliary hoist for removing the charge from the carriage and depositing it in the shielding pond at the lower station. In this way, if the hoist jams in operation, its charge may be removed and disposed of to afford access to the hoist for repair. Water sprays are also provided to prevent charge overheating. Drawings are included. (D.L.C.)

7474 PESTLE AND MORTAR. Harry Ernest Alfred Sefton and Derek Arthur Groves (to United Kingdom Atomic Energy Authority). British Patent 858,297. Jan. 11, 1961.

A pestle and mortar arrangement for grinding radioactive, toxic, or valuable materials without allowing powder to escape is designed wherein a transparent mortar is sealed by a gate valve and a lid in which a pestle is slidably mounted. In this way, the material need never come into contact with the atmosphere and, if necessary, the mortar may be evacuated and filled with an inert gas. (D.L.C.)

7475 IMPROVEMENTS RELATING TO CONTAINERS FOR RADIOACTIVE SOURCES. Clifford Kenneth Bes Wick (to Simon-Carves Ltd.). British Patent 858,388. Jan. 11, 1961.

A container for radiation sources in which a path for collimated radiation may be opened or closed with safety is described. A body of lead or other dense material has a passage to locate the source and a cylindrical valve member interposed in the passage, the valve having a passage coinciding with that in the body and arranged to be rotatable through 90° so that a path may be opened or closed for radiation by valve rotation. The body also may be formed with a plurality of passages and valve members when a plurality of collimated beams is desired. Metal sheaths may be provided on the outside of the body to protect it from abrasion and fire and in the interface between the body and the valve member to reduce abrasion due to rotation. (D.L.C.)

7476 POWER-OPERATED MANIPULATOR. John Alfred Marsh, Louis Thomas Bates, and David Humphreys (A. C. Wilson and Partners Ltd.). British Patent 859,162. Jan. 18, 1961.

A power-operated manipulator is designed for remote handling of large loads on the order of one ton. The manipulator comprises a carriage movable along a longitudinal track and a cross trolley movable along a transverse track carried by the carriage, the trolley supporting a vertical telescopic arm. Individual hydraulic motors are provided for driving each of the moving elements of the manipulator. (D.L.C.)

7477 IMPROVEMENTS IN VACUUM PUMPS OF THE GETTER TYPE. Robert Auzolle, Paul Chaumette, Paul Garin, and Pierre Praugne (to Commissariat à l'Énergie Atomique). British Patent 859,515. Jan. 25, 1961.

An improved getter vacuum pump is designed wherein the feed mechanism which supplies the heater with getter metal wire is located in a gas-tight casing outside the vacuum chamber. Thus, difficulty due to heating of the mechanism is avoided. (D.L.C.)

7478 IMPROVEMENTS IN OR RELATING TO COMPRESSORS. Everett Long (to United Kingdom Atomic Energy Authority). British Patent 859,615. Jan. 25, 1961.

A compressor for fluids is designed with a rotary driving shaft and a labyrinth sealing gland. The gland incorporates a bleed pipe with a filtering device; any leakage in the gland results in a flow of fluid in the bleed pipe, and any filterable contaminants, e.g., oil or oil vapor, are removed. Easy access is provided to the motors (one of which is auxiliary) for maintenance and overhaul. This compressor design is especially applicable to gas-cooled reactors where coolant contamination must be avoided. (D.L.C.)

7479 CENTRIFUGAL PUMP AND SHAFT SEALING MEANS. F. C. Rushing (to U. S. Atomic Energy Commission). U. S. Patent 2,951,448. Sept. 6, 1960.

A description is given of sealing means between a hollow rotatable shaft and a stationary member surrounding the shaft which defines therewith a sealing space of annular cross-section, comprising a plurality of axially spaced rings held against seats by ring springs which serve to subdivide the sealing space into a plurality of zones. Process gas introduced into the hollow shaft through a port communicating with a centrally located zone which in turn communicates with a bore in the sleeve, is removed from the shaft through a second port communicating with an adjacent central zone and discharged through a second bore. A sealant gas is supplied to an end zone under a pressure sufficient to cause it to flow axially into adjacent zones and then maintained at a lower pressure than either the sealant gas source or the process gas inlet zone, preventing the sealant gas from entering the shaft and allowing gases leaking into the sealant gas to be withdrawn and led to a separator.

7480 GAS BEARING. C. W. Skarstrom (to U. S. Atomic Energy Commission). U. S. Patent 2,951,729. Sept. 6, 1960.

A gas lubricated bearing for a rotating shaft is described. The assembly comprises a stationary collar having an annular member resiliently supported thereon. The collar and annular member are provided with cooperating gas passages arranged for admission of pressurized gas which supports and lubricates a bearing block fixed to the rotatable shaft. The resilient means for the annular member support the latter against movement away from the bearing block when the assembly is in operation.

7481 CUSHIONED BEARING. F. C. Rushing (to U. S. Atomic Energy Commission). U. S. Patent 2,951,730. Sept. 6, 1960.

A vibration damping device effective to dampen vibrations occurring at the several critical speeds encountered in the operation of a high-speed centrifuge is described. A self-centering bearing mechanism is used to protect both the centrifuge shaft and the damping mechanism. The damping mechanism comprises spaced-apart, movable, and stationary sleeve members arranged concentrically of a rotating shaft with a fluid maintained between the members. The movable sleeve member is connected to the shaft for radial movement therewith.

7482 CENTRIFUGE. Frank C. Rushing (to U. S. Atomic Energy Commission). U. S. Patent 2,951,731. Sept. 6, 1960.

A vibration damping mechanism for damping vibration forces occurring during the operation of a centrifuge is described. The vibration damping mechanism comprises a plurality of nested spaced cylindrical elements surrounding the rotating shaft of the centrifuge. Some of the elements are held substantially stationary while the others are held with respect to a pair of bearings spaced along the rotating shaft. A fluid is retained about the cylindrical elements.

7483 REFRIGERATION ESPECIALLY FOR VERY LOW TEMPERATURES. P. B. Kennedy and H. R. Smith, Jr. (to U. S. Atomic Energy Commission). U. S. Patent 2,952,139. Sept. 13, 1960.

A refrigeration system for producing very low temperatures is described. The system of the invention employs a binary mixture refrigerant in a closed constant volume, e.g., Freon and ethylene. Such mixture is compressed in the gaseous state and is then separated in a fractionating column element of the system. Thenceforth, the first liquid to separate is employed stagewise to cool and liquefy successive portions of the refrigerant at successively lower temperatures by means of heat exchangers coupled between the successive stages. When shut down, all of the volumes of the system are interconnected and a portion of the refrigerant remains liquid at ambient temperatures so that no dangerous overpressures develop. The system is therefore rugged, simple and dependable in operation.

7484 PUMP CONSTRUCTION. G. Strickland, F. L. Horn, and H. T. White (to U. S. Atomic Energy Commission). U. S. Patent 2,953,993. Sept. 27, 1960.

A pump which utilizes the fluid being pumped through it as its lubricating fluid is described. This is achieved by means of an improved bearing construction in a pump of the enclosed or canned rotor type. At the outlet end of the pump, adjacent to an impeller mechanism, there is a bypass which conveys some of the pumped fluid to a chamber at the inlet end of the pump. After this chamber becomes full, the pumped fluid passes through fixed orifices in the top of the chamber and exerts a thrust on the inlet end of the pump rotor. Lubrication of the rotor shaft is accomplished by passing the pumped fluid through a bypass at the outlet end of the rotor shaft. This bypass conveys pumped fluid to a cooling means and then to grooves on the surface of the rotor shaft, thus lubricating the shaft.

7485 LOW-LOSS CABLE AND METHOD OF FABRICATION. R. L. McCarthy, et al. (U. S. Atomic Energy Commission). U. S. Patent 2,954,421. Sept. 27, 1960.

A radiation-resistant coaxial electrical cable capable of carrying very small currents at high voltages with little leakage is described. The cable comprises an inner axial conductor separated from an outer coaxial tubular conductor by annular layer of fibrous silica insulation. The silica insulation is formed by leaching boron from spun borosilicate glass and then heat treating the silica at a high temperature.

7486 CAVE WINDOW. M. Levenson (to U. S. Atomic Energy Commission). U. S. Patent 2,957,210. Oct. 25, 1960.

A cave window is described. It is constructed of thick glass panes arranged so that interior panes have smaller windowpane areas and exterior panes have larger areas. Exterior panes on the radiation exposure side are remotely replaceable when darkened excessively. Metal shutters minimize exposure time to extend window life.

7487 SEALING MEANS FOR RELATIVELY ROTATABLE MEMBERS. C. S. Skarstrom (to U. S. Atomic Energy Commission). U. S. Patent 2,957,709. Oct. 25, 1960.

A sealing means is offered for maintaining a seal between a pair of relatively rotatable members, particularly between a rotating shaft and a stationary member surrounding the shaft. The sealing is accomplished by means of a flange extending outward radially on each of a plurality of sealing rings mounted on the rotating member which fit into annular grooves in the stationary member and are held in sealing relation therewith by means of spring rings. In addition, means are provided for passing a sealing gas through the seal surfaces to prevent accumulation of lubricant and for scavenging any gas which may have leaked from the internal member into the seal area.

7488 FLUID CONTROLLING MEANS. H. N. Pouliot (to U. S. Atomic Energy Commission). U. S. Patent 2,959,326. Nov. 8, 1960.

A device is described for releasing fluid from a container and delivering it to an outlet conduit. An explosive squib moves a piston so as to cut a wall section from the conduit and to punch a hole in the container, whereby a

fluid may pass from the container into the conduit. A deformable sleeve retains the piston in its final position.

7489 ION PUMP. N. Milleron (to U. S. Atomic Energy Commission). U. S. Patent 2,967,257. Jan. 3, 1961.

An ion pump and pumping method are given for low vacuum pressures in which gases introduced into a pumping cavity are ionized and thereafter directed and accelerated into a quantity of liquid gettering metal where they are absorbed. In the preferred embodiment the metal is disposed as a liquid pool upon one electrode of a Phillips ion gauge type pump. Means are provided for continuously and remotely withdrawing and degassing the gettering metal. The liquid gettering metal may be heated if desired, although various combinations of gallium, indium, tin, bismuth, and lead, the preferred metals, have very low melting points. A background pressure of evaporated gettering metal may be provided by means of a resistance heated refractory metal wick protruding from the surface of the pool of gettering metal.

Heat Transfer and Fluid Flow

7490 (KAPL-M-AWH-1) AN INVESTIGATION OF HEAT TRANSFER UNDER STEADY STATE AND NON-UNIFORM HEAT GENERATION IN AN IRRADIATION SPECIMEN. A. W. Hudak (Knolls Atomic Power Lab., Schenectady, N. Y.). Nov. 25, 1960. 13p. Contract W-31-109-Eng-52.

The temperature distribution and surface heat flux with nonuniform heat generation were determined for an instrumented irradiated specimen. Descriptions are given of the boundary conditions, dimensional data, nodal representations, and power distributions for the specimen. A tabulation of the nodal temperatures shows a maximum of 894°F. The temperature distribution is shown on a nodal diagram of the specimen, along with a tabulation of the surface heat flux. The internal heat generation was maximized to a nodal power factor (F_p) of 1.45 along the width, but the surface heat flux is practically constant over that distance. The ratio of the peak surface heat flux to the nominal surface heat flux, 10^6 Btu/hr/sq ft, was found to be 1.02. (B.O.G.)

7491 (KAPL-M-NPA-19) NATURAL CIRCULATION STEAM GENERATOR ANALYSIS. C. J. Meyer (Knolls Atomic Power Lab., Schenectady, N. Y.). Aug. 15, 1960. 16p. Contract W-31-109-Eng-52.

Analyses of a steady-state natural circulation steam generator are presented. Void formations are assumed to occur only in the evaporator, riser, and steam separators. The evaporator section is assumed to consist of a preheat section and a boiling section. The boiling is assumed to occur in such a fashion that the void fraction of steam in the evaporator varies linearly over the boiling section. It is further assumed that the void fraction in the risers and separators is equal to that at the evaporator exit and remains constant up to the second stage of separation. (W.L.H.)

7492 (NAA-SR-Memo-4513) GENERALIZED CURVES FOR FREE CONVECTION HEAT TRANSFER WITH AIR. C. J. Baroczy (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Nov. 30, 1959. 11p. OTS.

A set of general curves were formulated in nomograph form which permit rapid, accurate determination of free-convection heat-transfer film coefficients for any surface in air under either heating or cooling conditions. (W.L.H.)

7493 (NP-9757) HEAT TRANSFER FLUIDS FOR NUCLEAR POWER GENERATION. Literature Abstracts 1957–1959. (North Carolina State Coll., Raleigh). Oct. 14, 1960. 204p. Contract Nonr-486(03).

A literature survey covering the period 1957 to 1959 is presented. Sources include Engineering Index, Chemical Abstracts, and Nuclear Science Abstracts. A subject index is included. 511 references. (J.R.D.)

7494 (TID-11501) A NUMERICAL TREATMENT OF ONE-DIMENSIONAL NON-STEADY COMPRESSIBLE. For Los Alamos Scientific Lab., N. Mex. (thesis). Paul J. Kazek (New Mexico. Univ., Albuquerque). 1960. 66p.

A numerical method for dealing with one-dimensional nonsteady compressible flows characterized by the presence of large amplitude compression and rarefaction waves is presented. Problems for which analytic solutions exist are used to test the flexibility and accuracy of the method. (J.R.D.)

7495 (NP-tr-538) ON HEAT OR MASS TRANSFER BETWEEN THE FLUIDIZING AGENT AND THE SOLID PARTICLES OF THE FLUIDIZED BED. E. Ruckenstein and I. Teoreanu. Translated for U.K.A.E.A. Atomic Energy Research Establishment from Acad. rep. populare Romîne, Inst. fiz. atomică şi Inst. fiz. Studii cercetări fiz., 11: 117-28(1960). 25p.

This paper was previously abstracted from the original language and appears in NSA, Volume 14, as abstract No. 21652.

7496 (NP-tr-550) HYDRAULICS OF GAS-LIQUID SYSTEMS. S. S. Kutaat Kutateladze and M. A. Styrikovich. Translation from a publication of Publishing House of Power Engineering, Moscow-Leningrad, 1958. 305p.

The most essential laws governing the combined motion of a gas-liquid system are systematically described. The problems considered are: the flow of gas-liquid systems in tubes; motion of discrete bubbles and drops in entraining media; downflow of liquid films; discharge of a gas into a liquid; dynamic two-phase layers; two-phase flow in circular tubes; atomization of liquids by mechanical and pneumatic spray nozzles; drop entrainment by a gas stream and drop separation from the stream; hydrodynamic theory of critical changes in heat transfer during boiling on heating surfaces; and some problems in experimental techniques. The book is designed for workers in the fields of physical-heat engineering, power engineering, hydromechanics, chemical processes, and equipment. A bibliography is given of 81 references to sources pertaining to the problems discussed, as well as to related problems not considered. (B.O.G.)

7497 (SCL-T-355) EXCERPTS FROM RADIANT HEAT TRANSFER. RADIATION FROM THE SHOCK LAYER AND MEASUREMENT OF THE EMISSION FACTORS OF METALS. H. de L'Estoile and L. Rosenthal (North Atlantic Treaty Organization, Paris. Advisory Group for Aeronautical Research and Development). Translated by Marcel I. Weinreich (Sandia Corp.) from report AGARD-211. Oct. 1958. 69p.

The radiant heat transfer from the shock layer when the ogives of ballistic missiles reenter the atmosphere is evaluated and compared with that caused by convection at the stagnation point and with the flow radiated by the wall. The case of an ogive of specified shape and weight is examined in relation to the distance and several types of ogives, which differ only in the radius of curvature of the surface near the stagnation point, are compared for a given range. The effects of a variation in the mass of the

ogive is examined for various ranges. Numerical results are presented as a basis for general conclusions on the relative extent of the radiant heat transfer from the shock layer and on the choice of value for the emission factor of the surface. (auth)

7498 THE METHOD OF SUCCESSIVE APPROXIMATIONS OF M. E. SHVETS APPLIED TO THE CALCULATION OF BOUNDARY LAYERS IN COMPRESSIBLE GASES. G. A. Kulonen. Vestnik Leningrad. Univ. 15, No. 1, Ser. Mat. Mekh. i Astron. No. 1, 123-31(1960). (In Russian)

The method of successive approximations is used for solving the laminar-boundary-layer problem in a compressible gas on the porous flat plate under the arbitrary change of the vertical velocity component on the wall. The method is illustrated by examples. When $v_w \sim (1/\sqrt{x})$, a comparison with the exact solution is given. (auth)

7499 LAMINAR BOUNDARY LAYER ON A POROUS SURFACE. G. A. Kulonen. Vestnik Leningrad. Univ. 15, No. 13, Ser. Mat. Mekh. i Astron. No. 3, 115-30(1960). (In Russian)

The laminar-boundary-layer problem in the absence of a pressure gradient and with a pressure gradient on the porous surface is considered for the case where the properties of the injected gas are identical or not too different from the properties of the free-stream gas. Crocco's variables are used for the case of the flat plate (zero pressure gradient). Differences of boundary-layer values for the porous surface and in the absence of the gas injection are introduced. The method of the linearization is used for the solution of the received equations. (auth)

Instrumentation

7500 (AERE-M-650) TRANSISTORS IN EXPERIMENTAL WORK. F. M. Russell (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Aug. 1960. 35p.

A review of transistor theory and information on transistor circuit design are presented in a form which may be readily usable in experimental work. (J.R.D.)

7501 (AERE-M-772) AIR SAMPLING UNITS. K. E. G. Perry (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Nov. 1960. 10p.

A new design of air sampling unit has been developed for collecting the particulate contamination in air on a filter paper. The unit is suitable for continuous operation. Also described is a new design of filter paper retainer that can be used with these units and with existing units. (auth)

7502 (AERE-R-3524) FISSION MEASUREMENTS WITH SURFACE BARRIER SOLID STATE IONIZATION CHAMBERS. E. Melkonian (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Oct. 1960. 41p.

The fabrication and use of gold-germanium and gold-silicon surface-barrier detectors for the detection and energy measurements of fission fragments are discussed. Measurements are presented of the energy spectrum of the α-particles from uranium, and of the fission fragments from neutron-induced fission of U^{235}. A method of obtaining the mass distribution of the fission fragments as a function of the total kinetic energy of the two fragments is described, and results presented: an estimate is also made of the frequency of occurrence of ternary fission in U^{235}. The usefulness of the solid-state detectors in the measurements of fission cross section as a function of neutron energy is pointed out and illustrated by a measurement of the fission yield of U^{233} when bombarded by neutrons in the energy range 5 to 20 ev. (auth)

7503 (APEX-576) DYNAMIC ANALYSIS OF A PNEUMATIC AMPLIFIER. B. Kaplan and J. A. Delaney (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). July 1960. 47p. Contracts AF33(600)-38062 and AT(11-1)-171.

An analysis leading to two sets of differential equations that describe the transient behavior of a high-temperature pneumatic amplifier under conditions of isothermal or adiabatic operation is presented. The equations are nonlinear and include the effect due to Coulomb friction, and their solution requires the use of a computer. With the assistance of a computer, the effect of varying certain parameters on the dynamic response of the amplifier can be determined. The program solves numerically the set of differential equations describing the transient response of a high-temperature pneumatic amplifier under conditions of isothermal operation. Critical or noncritical flows through all orifices are taken into account. (auth)

7504 (BM-RI-5708) DESIGN CRITERIA FOR PORTABLE SEISMOGRAPHS. Wilbur I. Duvall (Bureau of Mines, Washington, D. C.). Apr. 1960. 8p.

Design criteria are deduced which assure that a seismograph will respond accurately to vibration levels as large as $\frac{1}{2}$ g. The coefficient of friction between the feet and the surface on which the instrument rests should be as large as possible, preferably approaching unity, the center of gravity of the instrument should be vertically above the centroid of the three-point mount, and the vertical distance between the center of gravity of the instrument and the centroid of the three points of contact with the surface should be less than the perpendicular distance between the centroid point and any one of the three sides of the triangle formed by the three points of contact. Portable seismographs that do not satisfy these conditions should be clamped to the surface if vibration levels above 0.1 g. are to be recorded. (auth)

7505 (CEA-1229) MESURE ABSOLUE DE L'ACTIVITÉ DES ÉMETTEURS β AU COMPTEUR 4 π. (Absolute Measurement of β Emitters with a 4 π Counter). Yves Le Gallic (France. Commissariat à l'Énergie Atomique. Centre d'Études Nucléaires, Saclay). 1960. 60p.

Thesis submitted to Univ. of Paris.

An investigation was made of the conditions under which the activity of β-emitting radionuclides may be measured with a maximum of precision, and as a result to study the relevant corrections. The various problems relating to activity measurements with a 4 π counter were examined successively: comparison of 4 π, G-M and proportional counters; study of the preparation of sources; corrections on the counting of sources; self-absorption; and correction for absorption. The precision obtained on these measurements varies from 1.2 to 3%, with the result that the 4 π counter can be considered a very satisfactory calibration instrument. (auth)

7506 (CEA-1594) ANALYSE PAR SPECTROMETRIE α (CHAMBRE A GRILLE) (PROSERPINE). (Analysis by α Spectrometry (Chamber with a Grid) (Proserpine)). C. Clouet d'Orval (France. Commissariat à l'Énergie Atomique. Centre d'Études Nucléaires, Saclay). 1960. 20p.

Various substances in an electrolytic deposit are compared by means of their α radiation. The energies are

separated by counting in a chamber with a grid, specially designed for the analysis of plutonium. A resolution of 1.7% is normally obtained for plutonium bands. Pu^{239}–Pu^{233} and Pu^{239}–Pu^{238} mixtures were analyzed. (auth)

7507 (CF-59-10-60) A NEW SPECTROGRAPHIC, CONTROLLED-ATMOSPHERE, EXCITATION CHAMBER. R. E. Weekley (Oak Ridge National Lab., Tenn.). Oct. 14, 1959. 5p.

A spectrographic, controlled-atmosphere, excitation chamber was designed and is under construction. It embodies many improvements over the model in use and will permit rapid, convenient, and reproducible manipulation throughout the entire analytical procedure. (auth)

7508 (HW-62449(Suppl.)) PORTABLE DOSE-RATE INTEGRATOR—MARK I. SUPPLEMENTARY REPORT. A. N. Iverson (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Nov. 10, 1960. 10p. Contract AT(45-1)-1350.

A prototype dose integrator described in report HW-62449 and specification HWS-7451 was purchased and evaluated in the as-received condition. Evaluation of the instrument is described along with circuit modifications. Recommendations for future instruments of this type are included. (J.R.D.)

7509 (HW-66837) SCINTILLATION ALPHA DETECTION PROBES. R. A. R. Kent (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Sept. 12, 1960. 20p. Contract AT(45-1)-1350.

Scintillation α probes were designed and fabricated. The active screen areas are 2 by 4 in. and 2 by 7 in. These probes can be used with the various prototype 110-volt a-c operated transistorized α monitors. Actual α efficiency or geometry, defined as the ratio of indicated instrument α counts to the total number of disintegrations occurring from a known source under the active screen area, is $28.8 \pm 0.6\%$ for the 2- by 4-in. probe and $27.7 \pm 1.5\%$ for the 2- by 7-in. probe. The new scintillation probes have a uniform geometry to within the stated limits over the active screen area. The probes were evaluated, in a 4.5 r/hr radium gamma field, by connecting them to a transistorized α counter. When the probes were placed in this radium γ field, there were less than 2 counts/min produced as added background over the usual 2 counts/min background. The average geometry was 10%, with dose rate of 4.5 r/hr, under these conditions for several RCA phototubes checked. (auth)

7510 (KAPL-M-JWH-9) RELIABILITY OF TEMPERATURE MEASUREMENT IN THE HIGH-TEMPERATURE VACUUM SINTERING FURNACE. J. W. Harrison (Knolls Atomic Power Lab., Schenectady, N. Y.). Sept. 15, 1960. 10p. Contract W-31-109-Eng-52.

Details of an operation to substantiate optical pyrometer readings on heated powder metallurgy compacts by means of thermocouples are given. It was found that the optical pyrometer method gave readings in a high-temperature vacuum sintering furnace within 35°C of those obtained using a thermocouple. A tungsten–molybdenum thermocouple is an accurate method for use in this type furnace, and the compensation for a room temperature cold junction should be added algebraically. (J.R.D.)

7511 (LA-2490) GAMMA RADIATION DETECTOR AND WARNING SYSTEM. James B. Deal, Jr., Charles Pacheco, and Edward A. Humphrey (Los Alamos Scientific Lab., N. Mex.). Nov. 1960. 16p. Contract W-7405-eng-36.

A γ radiation detection and warning system is described which is installed in the plutonium processing area of the Los Alamos Scientific Laboratory. The system consists of 15 ionization chamber γ-sensing elements and 81 alarm horns interconnected through a single, remotely located, control console. (auth)

7512 (NAA-SR-Memo-5777) TEST OF LINEAR INDUCTION ELECTROMAGNETIC PUMP FOR HNPF. R. S. Baker (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Oct. 26, 1960. 4p.

Investigations to determine the characteristics of electromagnetic pumps constructed for the Hallam Nuclear Power Facility are described. Resulting data are incorporated in curves of pressure vs. flow, and efficiency vs. flow obtained with sodium at 600°F. (J.R.D.)

7513 (NP-9704) GUINIER-TYPE X-RAY FOCUSING CAMERA FOR STUDY OF THIN FILMS. Research Report 6-40807-11-R3. R. J. Ruka and K. F. Andrew (Westinghouse Electric Corp. Research Labs., Pittsburgh). May 29, 1959. 28p.

An x-ray-diffraction powder camera of the Guinier-Hägg design is described. The camera is particularly suitable for the study of polycrystalline films ranging in thickness from 100 to 250,000 A and to as low as 0.1 μg in weight. Sensitivity for detection of minor phases is high. A procedure is described for obtaining accurate values of interplanar spacings in the region $\theta \cong 10$ to 45° which eliminates the use of a calibration curve or extrapolation method. (auth)

7514 (NP-9706) A RADIATION TECHNIQUE FOR THE MEASUREMENT OF THERMAL CONDUCTIVITY OF SEMICONDUCTORS BETWEEN 1000 AND 2000°C. Annual Progress Report covering Period March 1, 1960 to December 31, 1960. (Little (Arthur D.) Inc., Cambridge, Mass.). Dec. 31, 1960. 37p. Contract Nonr-2974(00). (ALI-C-62403).

A summary of the experimental work performed on the measurement of thermal conductivity of semiconductors at 1000 to 2000°C is given. The experimental procedures developed for carrying out thermal conductivity tests, the apparatus constructed to perform the tests, methods for measuring temperatures and heat flux, calibration procedures, thermal conductivity calculation procedures, and plans for future work are given. (For preceding period see ALI-C-62403.) (auth)

7515 (ORNL-3018) INTERFACIAL AREA MEASUREMENT IN LIQUID–LIQUID SYSTEMS BY RADIOISOTOPES. II. THE USE OF A LIQUID SCINTILLATOR. C. V. Chester and J. S. Newman (Oak Ridge National Lab., Tenn.). Feb. 3, 1961. 24p. Contract W-7405-eng-26.

A technique for measuring interfacial area between an aqueous solution of an α emitter and a liquid scintillator was devised. The short-range α particles produce light scintillations in the organic phase within a few microns of the liquid interface, which are detected by a photomultiplier, analyzed by appropriate pulse circuitry, and counted. A theoretical relation for extracting the interfacial area from the observed count rate was derived. In the technique it is necessary to include a light absorber to offset the scattering effects of the droplets; otherwise, the specific interfacial area would be independent of the measured count rate. In a preliminary series of experiments, the interfacial area produced in a small mixer was measured and found to be proportional to the 1.6 power of the impeller speed. This technique of measuring interfacial area has the advantage of requiring very low activity levels and is amenable to rather exact mathematical analysis. (auth)

7516 (ORO-361) MASS SPECTROMETRY INSTRUMENTATION. Annual Report and Research Proposal (Renewal). M. K. Testerman (Arkansas. Univ., Little Rock. Graduate Inst. of Tech.). Sept. 23, 1959. 88p. Contract AT(40-1)-2123.

A study of the properties associated with various metallic surfaces, relative to their application in ion source generation, was performed. Proved by this study is the feasibility of a system utilizing a combination of photoelectric emission and secondary electron multiplication as a cold electron source. The detailed study of the various phases of investigation (1-Photoelectric emission; 2-Secondary electron multiplication; 3-Application in a mass spectrometer) is described. As a result of this investigation, a design was evolved in which ultraviolet radiation from a hydrogen arc lamp is transmitted through a sapphire window to impinge upon a tantalum photocathode. The photoelectric electrons then are multiplied by a 10- or 16-stage secondary multiplier. The electron output of the multiplier then is used for ionization. This cold electron source was used in an extremely dirty mass spectrometer tube, one which would be expected to abbreviate sharply the life of the source; yet, good spectra were obtained despite these conditions. Therefore, it is surmised that long reliable operation might well be anticipated if this source were applied to a clean mass spectrometer tube, pumped with a Varian Vacion pump. Unlike that associated with thermionic emitters, electron emission utilizing this cold source does not undergo wild excursions; thus, emission regulation should be easily facilitated. It is believed that this type of cold electron source might be used to advantage in other instruments involving ion generation, since it possesses several unique properties, one of which is rapid or high frequency modulation of electron generation. (auth)

7517 (SCDR-280-60) DESIGN CRITERIA FOR PRINTED CIRCUIT BOARDS. (Sandia Corp., Albuquerque, N. Mex.). Nov. 1960. 62p.

Principles of good printed wiring board design practice are presented which have been proven by test results and practical experience to yield the simplest and most reliable product at minimum cost. (auth)

7518 (SCTM-307-60(24)) USE OF DUAL-LEVEL LOGIC AIDS IN BLOCK DIAGRAM DEVELOPMENT. R. H. Braasch (Sandia Corp., Albuquerque, N. Mex.). Dec. 1960. 18p.

A logic system is developed for use in design procedures involving the application of common emitter transistor circuits operating in the switching mode. The presence of common emitter transistor switches normally requires the use of Sheffer Stroke (Not-And) and/or Nor (Not-Or) logic functions to describe the resultant logic behavior in circuit applications, because of the inherent phase reversal in transfer characteristics. A dual-level logic convention is proposed whereby the procedure for noninverting circuitry is applied to inverting circuitry. The characteristic phase reversal need not be taken into account if reverse level is satisfactory as an output. (auth)

7519 (SCTM-352-60(27)) MEASUREMENT OF THE DIRECTIVITY OF A COAXIAL DIRECTIONAL COUPLER BY USE OF A LENGTH OF PRECISION TRANSMISSION LINE. W. E. Little (Sandia Corp., Albuquerque, N. Mex.). Jan. 1961. 22p.

The quarter-wavelength line method of measuring the directivity of a coaxial coupler is described. It gives the error analysis of the method in detail and shows that the method has the capability of precise and repeatable measurements. (auth)

7520 (TID-11357) FEASIBILITY DEMONSTRATION OF A PNEUMATIC TEMPERATURE SENSER. Test Report. Report No. 512-534-123. P. H. Zabel (Marquardt Corp., Van Nuys, Calif.). Aug. 18, 1960. 33p. OTS.

A feasibility test was made on a pneumatic temperature senser that determines the total temperature of a gas stream by producing a proportional pressure ratio. The senser proved to be a rugged device with an accuracy limited only by the pressure transducers. The senser is not pressure-level sensitive and is not affected by exhaust pressure until the exhaust orifice unchokes. The only compensation required was for T_{Tk} and that could be eliminated by designing the exhaust orifice to be self-compensating, easing heat exchanger requirements. Over a period of several days, with temperatures ranging from ambient to almost 1300°F, the senser required no adjustment or care. (W.L.H.)

7521 (TID-11417) DEVELOPMENT OF A PROTOTYPE LINE OF TWO MILLIMETER WAVELENGTH EQUIPMENT. Final Technical Report [for] Period July 14, 1958 to June 14, 1960. Andrew W. Swago (Illinois. Univ., Urbana. Electrical Engineering Research Lab.). Sept. 1, 1960. 33p. Contract AT(11-1)-663. OTS.

Details of developmental work performed on prototype 2-mm wavelength equipment are presented. Equipment components described include waveguide flanges, crystal multipliers, crystal detectors, bolometers, adjustable shorts, VSWR measuring devices, frequency meters, tapered transitions, horns, variable phase shifters, mode converters, power dividers, and attenuators. (J.R.D.)

7522 (TID-11548) TENTATIVE INSTRUCTIONS FOR FIELD USE OF IMPROVED HIGH ALTITUDE AIR FLOW METER MODEL PR-2. Report No. 2146. (General Mills, Inc., Minneapolis). Jan. 1, 1961. 15p. Contract AT(11-1)-401.

Instructions for use of a low-drag high-volume propeller type anemometer designed for measuring air or other gas flow are presented. A number of applications for this instrument have been found; however, it was designed to meet a specific need in connection with high-altitude balloon-borne particle- or gas-sampling systems. (J.R.D.)

7523 (AEC-tr-4387) A SIMPLE OPTICAL PYROMETRIC METHOD FOR THE DIRECT DETERMINATION OF THE TRUE TEMPERATURE OF INCANDESCENT METALS. Carl Tingwaldt. Translated by R. J. Fries, D. G. Rose, and Gretchen R. Riese (Los Alamos Scientific Lab.) from Z. Metallk. 51, 116-19(1960). 13p.

A method of optical pyrometry, which is especially suited to metallic emitters, is described. The glowing surface of a solid body emits a more or less polarized light along a direction that is inclined against the normal surface. By superposing a nonpolarized light beam with the same color and with adjustable intensity striking the surface at the same angle, polarized-reflected light can be obtained. This radiation is equivalent to that of a black body with the same temperature. Temperature measurement is based on this principle. (J.R.D.)

7524 (CEA-tr-A-841) DE LA DÉTERMINATION DE L'ACTIVITÉ SPÉCIFIQUE D'UN LIQUIDE À PARTIR DE L'INTENSITÉ DE DOSE MESUREE À LA SURFACE DE RÉSERVOIRS DE TUBES CYLINDRIQUES. (Determination of the Specific Activity of a Liquid from Dose Intensity Measured at the Surface of Cylindrical Tube Reservoirs). W. Kattwinkel. Translated into French from Atomkernergie 4, 446-9(1959). 18p.

This was previously abstracted and appears in NSA, Volume 14, as Abstract No. 4621.

7525 (CEA-tr-R-1074) ETUDE DES TEMPS DE RÉPONSE DES PHOTOMULTIPLICATEURS PAR LA MÉTHODE DES COINCIDENCES RETARDÉES. (Study of the Response Time of Photomultipliers by the Delayed Coincidence Method). E. E. Berlovich and B. A. Shilyaev (Shiliayev). Translated into French by B. Vinogradoff from Pribory i Tekh. Eksp. No. 1, 62-8(1958). 19p.

This was previously abstracted and appears in NSA, Volume 12, as Abstract No. 12523.

7526 (CEA-tr-R-1086) DÉBITMÈTRE ÉLECTRONIQUE DIFFÉRENTIEL. (Differential Electronic Flowmeter) V. (C.) I. Danilov, Yu. N. Denisov (Iu. N. Denissov), and V. P. Dmitrievskiĭ (Dmitrievsky). Translated into French by A. Khazov from Pribory i Tekh. Eksp. No. 2, 74-6 (1957). 8p.

An apparatus is described for measuring magnetic fields with rapidly varying heterogeneities. Two branched coils are mounted on a common shaft at a certain distance apart. They are connected so that their emf's oppose each other. A special coil turns the shaft through 180°. The effective surface of each measuring coil is about 800 cm^2 and they differ from each other by a maximum proportion of 0.002%. The sensitivity of the apparatus is 0.027 oersted/cm/division. (T.R.H.)

7527 (CEA-tr-R-1087) APPAREIL POUR LA MESURE DES LACUNES DANS LES TRACES DE PARTICULES DANS LES EMULSIONS PHOTOGRAPHIQUES. (Apparatus for Measurement of Gaps in Particle Tracks in Photographic Emulsions). A. P. Zhdanov, M. I. Kolpakov, V. N. Kuzmin, R. M. Raguzin (Raguzine), and P. I. Fedotov. Translated into French by B. Vinogradoff from Pribory i Tekh. Eksp. No. 1, 46-7(1958). 5p.

This was previously abstracted and appears in NSA, Volume 12, as Abstract No. 12600.

7528 (CEA-tr-R-1088) MESURES DE FAIBLES QUANTITES DE RADON ET DE THORON A L'AIDE D'UNE CHAMBRE D'IONISATION A IMPULSIONS. (Measurement of Small Quantities of Radon and Thoron with Ionization Chambers). A. M. Babeshkin, V. I. Baranov, and K. B. Zaborenko. Translated into French by B. Vinogradoff from Zavodskaya Lab., 8, 996-7(1958). 5p.

This paper was previously abstracted from the original language and appears in NSA, Volume 13, as abstract No. 11156.

7529 USE OF A Cs^{137} STANDARD OF SPECIAL DESIGN TO CALIBRATE SCINTILLATION SPECTROMETERS FOR CLINICAL I^{131} MEASUREMENT. Mary C. Morgan, Jeannette P. Pittman, and J. R. Risser (Veterans Administration Hospital, Houston, Tex. and Rice Inst., Houston, Tex.). Am. J. Roentgenol., Radium Therapy Nuclear Med. 85, 105-13(1961) Jan.

Simple and accurate methods for calibrating and maintaining the accuracy of equipment using pulse-height analysis for clinical I^{131} measurements were worked out. Complicated procedures involving knowledge of electronics and nuclear physics were avoided. The most important detail involved the use of a long-lived Cs^{137} standard which was made to simulate the characteristics of I^{131} by installation of a resistor set and switch in the linear amplifier such that superimposition of the cesium and iodine curve occurs, and modification of the Cs^{137} pulse spectrum by limited use of Compton scattering in an aluminum shield. Over a period greater than two years, consistency of measurements within 2% was obtained. (auth)

7530 STRAY RADIATION FROM THERAPEUTIC ROENTGEN-RAY BEAMS. A. F. Holloway (Ontario Cancer Treatment and Research Foundation, Kingston Clinic, Kingston). Am. J. Roentgenol., Radium Therapy Nuclear Med. 85, 152-7(1961) Jan.

The first part of this paper describes an experiment to measure the quantity and quality of radiation scattered through 90° from a water phantom, which was irradiated by incident radiation whose quality was varied from 0.35 mm Cu to 3.4 mm Cu. The shielding effects of a water shell between the edge of the beam and the edge of the phantom were investigated as well as the variation in scattered dose rate with field size and distance from the scattering material. In the second part of the paper the quantity and quality of scattered radiation are calculated on the basis of single scattering only and the results of these calculations are compared with the experimental results obtained in the first part. (auth)

7531 X-RAY IMAGE INTENSIFICATION WITH A LARGE DIAMETER IMAGE INTENSIFIER TUBE. Wilfrid F. Niklas (Rauland Corp., Chicago). Am. J. Roentgenol., Radium Therapy Nuclear Med., 85, 323-41(1961) Feb.

X-ray image intensification permits a reduction of the radiation doses in fluoroscopy as well as the application of cinematography and television techniques to medical radiology. X-ray intensifying systems, namely, electronic, solid state, and vacuum tube systems, are surveyed and the conclusion is reached that only vacuum tube systems have been developed to such a technical maturity as to permit successful practical application. The design of a large size vacuum tube x-ray image intensifier is described. Structural details such as the cross section profile of the x-ray window, location of the pickup screen, and linearity distortions are discussed. Further, the imaging by the electrostatic triode system, used in this tube, is analyzed mathematically with special emphasis on the properties of the negative anode aperture lens and the curvature of the image plane of such a system. The concept of a pseudo-point symmetric system is outlined together with the function of the high voltage coating, a new electron-optical element for structure of this type. Performance data of the large size x-ray image intensifier are listed in detail together with a thorough description of the measurement techniques used. (auth)

7532 A SIMPLE EFFICIENT LIQUID SCINTILLATOR FOR COUNTING AQUEOUS SOLUTIONS IN A LIQUID SCINTILLATION COUNTER. George A. Bray (National Heart Inst., Bethesda, Md.). Anal. Biochem. 1, 279-85(Dec. 10, 1960).

A modification of the naphthalene–dioxane–PPO liquid scintillator is described which will allow up to 3.0 ml of an aqueous solution to be counted. The efficiency of this method in the presence of 1.0 ml water is 65.6% for C^{14} and 11.7% for tritiated water. This liquid scintillator was used to count C^{14} and H^3 in urine, plasma, and liver homogenate. The effect of isotope concentration, solute concentration, and the presence of acids and bases on the count rate was investigated. (auth)

7533 EFFECT OF PULSE HEIGHT SELECTION ON TIME RESOLUTION IN SCINTILLATION COUNTERS. Teuvo Kohonen (Inst. of Tech., Helsinki, Finland). Ann. Acad. Sci. Fennicae, Ser. A, VI, No. 50, 3-11(1960).

The ultimate time resolution of the scintillator is calculated on the basis of a new theory, taking into account the effect of pulse-height distribution and amplitude selection of photomultiplier pulses. The form of the initial pulse-height distribution has no effect on the standard error of time. If the number of photoelectrons collected at the cathode $n \ll$ the total number N, the results approximate

those of Post and Schiff. If the size of light pulses is kept constant and n = N/2, the amplitude selection brings about an improvement by a factor of $1/\sqrt{2}$. (D.L.C.)

7534 DOUBLE FOCUSING BETA-RAY SPECTROMETER. Zdeněk Plajner and Luděk Malý (Inst. of Nuclear Research, Czechoslovak Academy of Sciences, Prague). Československ. časopis pro fysiku 10, 47-55(1960). (In Czech.)

A description is given of a double focusing β spectrometer. The radius of the central orbit of the instrument r_0 = 30 cm. The magnetic field, having the shape $H = H_0(1 - \frac{1}{2}q + \frac{3}{8}q^2 + \ldots)$, is excited with a magnet having an external magnetic yoke. The energy range of the spectrometer is up to 3.5 Mev. For a source 2 × 35 mm^2, the resolution of the spectrometer is 0.22%, and the transmission 0.43% of the complete solid angle. The maximum transmission of the instrument is 2.2%. The results of some measurements carried out for verificational purposes are given. (auth)

7535 THE USE OF GRAPHICAL METHODS IN MEASURING THE RADIOACTIVITY OF NUCLEAR FALL-OUT. Vilém Santholzer (Charles Univ., Prague). Československ. časopis pro fysiku 10, 56-62(1960). (In Czech.)

Systematic measurement of nuclear fall-out and the decrease of its activity with time provide a great deal of data for the elaboration of which a number of graphical methods are suitable. The essence of these methods is explained, and experience with them in elaborating experimental material over a number of years is described. (auth)

7536 DIGITAL INSTRUMENTATION FOR NUCLEAR RESEARCH TESTS. E. J. Wade (Knolls Atomic Power Lab., Schenectady, N. Y.). Electronics 33, No. 43, 68-71 (1960) Oct. 21.

A description is given for a 256-channel pulse analyzer which is used for neutron time-of-flight and pulsed-neutron measurements. The analyzer functioning is outlined for the pulsed-neutron test. Block and circuit diagrams are given of the analyzer and its components. (B.O.G.)

7537 SENSITIVE AMPLIFIER HELPS LOCATE TUMORS. Edwin Gordy and George Sieber (Roswell Park Memorial Inst., Buffalo). Electronics 34, No. 1, 123-4 (1961) Jan. 6.

An instrument was developed which mechanically scans a body region, using a scintillation counter fitted with a lead focusing-collimator. The instrument presents the tissue radiation level data or detected count rate as variations in the blackening of a sheet of photographic film. A block diagram of the circuits is included. Applications in the localization of tumors following differential uptake of I^{131} iodinated albumin are reported. (C.H.)

7538 SILICON JUNCTIONS DETECT POSITIVE IONS. F. A. White (Knolls Atomic Power Lab., Schenectady, N. Y.), J S. Sheffield, and J. W. Mayer. Electronics 34, No. 3, 74(1961) Jan 20.

A method was developed to detect low-energy positive ions with diffused or surface-barrier silicon junctions. Ions emerging from a spectrometer exit slit were allowed to impinge on the negative high-voltage terminal of a parallel-plate electron converter. Secondary electrons generated in this manner were accelerated to the grounded plate and passed through a small slit to the junction detector. (M.C.G.)

7539 X-RAY SPECTROMETER FOR SATELLITE. Engineer 28, 849(1960) Nov. 18.

A compact, transistorized x ray spectrometer was developed for use in the "Scout" space research satellite to obtain data for correlation of ionospheric behavior with solar x radiation. The spectrometer measures the x ray incidence rate in 5 energy bands within the range 2 to 13 A with a proportional gas counter and transfers the counter data to the telemetry system for transmission or magnetic tape storage. The spectrometer has four 5.5-in.-dia. card modules laminated together and is only 3 in. thick. (D.L.C.)

7540 HOTTEST-POINT SEEKER. J. W. Adams (E. I. duPont de Nemours & Co., Savannah River Plant). Instr. Control Systems 33, 2083-4(1960) Dec.

This memory system indicates the input line that has the highest signal level; it can show highest temperature if the system is scanning thermocouples or the extreme signal of any d-c input scanner. (auth)

7541 A UNIVERSAL FUNCTION FOR COMPUTING COUNTING PERFORMANCE. M. A. Greenfield (Univ. of California, Los Angeles) and R. L. Koontz. Intern. J. Appl. Radiation and Isotopes 8, 205-10(1960) Oct. (In English)

Formulas are developed for evaluating the statistical accuracy of systems that measure radioactivity, and a universal counting performance curve is given. Examples are given of problem solving. (auth)

7542 A LARGE-VOLUME 4π LIQUID SCINTILLATION DETECTOR. B. G. Dunavant and J. E. Christian (Purdue Univ., Lafayette, Ind.). Intern. J. Appl. Radiation and Isotopes 8, 223-7(1960) Oct. (In English)

This detector has a scintillator volume of 1 ft^3 and a sample chamber 4.25 in. in diameter and 8 in. long. Four 5-in. photomultiplier tubes give a photocathode coverage of about 10% of the detector's wall area. Good light collection efficiency results in the counter being relatively insensitive to source position in the sample chamber. The detector is housed in an iron shield providing 5 in. of shielding. Such detectors as the one described should find wide application, particularly in biological studies and clinical diagnosis. (auth)

7543 THE EFFECTIVE RANGE OF A NUCLEAR EXPLOSION FOR ELECTRONIC EQUIPMENT. J. R. Crittenden (General Electric Co., Owensboro, Ky.). IRE WESCON Conv. Rec. 4, Pt. 6, 141-7(1960).

A short, intense pulse of nuclear radiation can produce transient disturbances in electronic devices. The transient may seriously affect the performance of electronic circuits and equipment. Analysis of the transient disturbances indicated that a short intense pulse of nuclear radiation creates low resistance electrical leakage paths. The effect is to distort circuit performance for the duration of the anomaly. Comparison of experimental pulse intensities with the pulse emitted by a nuclear explosion revealed that equivalent conditions exist at surprisingly great distances—extending the effective range of the explosion more than five times. (auth)

7544 MEASUREMENT OF FAST NEUTRON FLUX IN A REACTOR BY MEANS OF THRESHOLD DETECTORS. Delfina Ricabarra, Rosa Turjanski, and A. H. W. Aten, Jr. (Comisión Nacional de la Energia Atómica, Buenos Aires, Argentina). J. Nuclear Energy, Pt. A. Reactor Sci. 12, 177(1960).

A study of cross sections of (n,p) reactions with P^{31} and S^{32} at different neutron energies indicates that the extrapolated threshold energies are equal and that the ratio of cross sections is roughly constant at different energies if the resonances are smoothed. Pairs of these samples were irradiated in thermal fluxes of 10^{10} n/cm^2 sec in various positions in the graphite and between the fuel elements of the R.A.1 reactor, so as to give a range of fast fluxes varying by a factor of 300. The activities of Si^{31} and P^{32} from

these reactions showed the same ratio in all cases within the accuracy of the measurements. Examination of published cross sections for the fission-neutron-energy spectrum gives $\sigma P^{32}/\sigma S^{32} = 0.44$. Hughes, Spatz, and Goldstein derived a value of 0.63, whereas the present value was 0.51 with a probable error of ~0.03. (B.O.G.)

7545 CADMIUM RATIO MEASUREMENTS WITH THIN AND THICK GOLD FOILS AND THEIR RELATION TO REACTOR SPECTRA. B. Fastrup (Danish Atomic Energy Commission Research Establishment, Risö). J. Nuclear Energy, Pt. A. Reactor Sci. 12, 177-8(1960).

A method is given for obtaining corrections to cadmium ratio measurements for flux depressions in the foil and flux perturbation effects in order that the result may be used in descriptions of the reactor neutron-energy spectrum. The effects are accounted for by introducing combined flux-depression and flux-perturbation factors, one for each of the three spectral shapes: (a) $h^M(X)$ for the Maxwellian flux; (b) $h^e(X)$ for the epithermal flux, $E > \mu kT$; and (c) $h_{cd}(X)$ for the resonance flux, $E > E_{cd}$, where X is the foil thickness. The values of $H^M(X)$ and $H^e(X)$ were determined experimentally with gold foils. These values are given as a function of the foil thickness from 0 to 100 mg/cm^2. (B.O.G.)

7546 DETECTION OF EXTREMELY LOW GAMMA ACTIVITIES WITH SCINTILLATION DETECTORS. O. Nováková and J. Silar. Jaderná energie 11, 365-78 (1960). (In Czech)

Basic parameters of scintillation detectors used for the detection of extremely low γ activities are analyzed. Definitions for detector sensitivity are given as well as the detector sensitivity threshold and factors influencing its long term stability. From statistical considerations, the relations for measurement time calculation at the required accuracy for detector evaluation, with regard to the low γ activity detection and for the most convenient detector parameter setting, are derived. Some scintillation detector designs that are estimated from the point of view of the minimum total and specific activity are described. (auth)

7547 THE SENSITIVE GAMMA-BACKGROUND AND SURFACE BETA-CONTAMINATION DETECTOR. F. Běhounek and J. Kočí. Jaderná energie 11, 379-82(1960). (In Czech)

A sensitive portable γ-background and surface β-contamination pointer-type detector was designed, using available design elements. The instrument was radiometrically calibrated and tested. The instrument may be used not only for personnel radiation protection dosimetry but also for civil radiation protection. By means of this instrument, the rapid determination of natural environmental γ radiation increase caused by nuclear reactors and hot cell wastes as well as by nuclear bomb tests is possible. (auth)

7548 A 5-CHANNEL TIME ANALYZER FOR DETERMINATION OF DECAY TIMES OVER 10^{-5} Sec. H. Döhler (Zentralinstitut fur Kernphysik, Rossendorf, Ger.). Kernenergie 3, 979-83(1960) Oct.-Nov. (In German)

A quartz-controlled 5-channel time analyzer is described in which channel widths from 10^{-5} sec to 10^{-1} sec can be changed in 9 steps. The precision and constancy of the channel width corresponds to the precision of the quartz and amounts to 10^{-4} for each adjustment. (tr-auth)

7549 APPLICATIONS OF RADIOACTIVE LEVEL GAGES AND LEVEL INDICATORS. M. A. Veksler. Khim. Prom. No. 6, 483-7(1960) Sept. (In Russian)

A remote-control level gage (UP-2) designed with an arc-shaped tubular bracket encircling the liquid container is described. One end of the bracket is equipped with a radiation source while the other end carries a γ counter (AMM-7). The bracket can be placed below the liquid level, where the number of counts is (N_1), then above the liquid level (N_2), and then at the boundary between the media (N_3). The position of the bracket is indicated by an induction transmission. A level regulator, RUR-3, designed on the same principle, is used for measuring the liquid level in high-pressure apparatus. Safety and efficiency tests show favorable results; however, additional improvements are indicated. (R.V.J.)

7550 THE NITROUS OXIDE DOSIMETER. R. W. Hummel and J. A. Hearne (Wantage Radiation Lab., Berks, Eng.). Nature 188, 734-5(1960) Nov. 26.

Nitrous oxide has been proposed as a suitable material for the dosimetry of ionizing radiations over wide temperature and pressure ranges and for a wide variety of types of radiation. An investigation was made of the radiolysis of nitrous oxide, and a comparison was made of absolute measurements of tritium as an internal source with measurements based on ferrous or ceric sulfate dosimetry, using Co^{60} γ-rays or 4-Mev x rays as external sources. Good agreement was obtained between the two methods for irradiations carried out in vessels with internal diameters greater than ~ 15 to 20 mm. The products measured were N_2, O_2, and the oxides of nitrogen ($NO + NO_2$). $G(N_2)$ was 11.0 ± 0.4 at ambient temperatures and is the average from all the types of radiation used, weighted in favor of the tritium irradiations. (B.O.G.)

7551 DETECTING LIQUID METAL LEVELS. A. Stead and F. G. Latham (United Kingdom Atomic Energy Authority, Capenhurst). Nuclear Power 5, 107-8(1960) Dec.

An instrument was developed to measure the level of sodium–potassium coolant for the Dounreay Fast Reactor in a sealed system. The inductive or eddy-current method was used to design a dipstick and an instrument for defining fixed levels in a standpipe. Because of the high temperature, the transformers are wound on a heat-resistant core. The wire is nickel-plated copper, insulated with silicon-impregnated glass fiber. (M.C.G.)

7552 PROGRESS IN TECHNOLOGY. 2. NUCLEONIC INSTRUMENTATION. D. Taylor (Plessey Nucleonics Ltd., [Northampton, Eng.] and Hagen Controls Ltd., [Eng.]). Nuclear Power 6, No. 57, 77-9(1961) Jan.

Some of the trends in radiation and particle detection instruments and techniques are briefly reviewed: neutron detectors for high-temperature use, plastic scintillators, solid state (semiconductor) detectors, use of organic phosphors with long output light pulses from recoil protons, portable γ spectrometers, impactor technique for air monitoring for plutonium, multichannel pulse-amplitude analyzers with tape, and transistorized instruments for reactors. (D.L.C.)

7553 TECHNIQUES OF FAST COINCIDENCES WITH SLOW SCINTILLATORS. (REVIEW). A. N. Pisarivskiĭ and L. D. Soshin (Radium Inst., Academy of Sciences, USSR). Pribory i Tekh. Ekspt. No. 6, 3-13(1960) Nov.-Dec. (In Russian)

Various coincidence methods with high resolving power were studied with transducers in NaI(Tl) and CsI(Tl) type scintillation counters. (tr-auth)

7554 METHOD FOR IMPROVING MEASUREMENTS OF RADIOACTIVE FLUXES. Yu. P. Betin, B. I. Verkhovskiĭ, N. G. Zelevinskaya, and V. V. Yakushin (Inst. of

Physics, Academy of Sciences, USSR). Pribory i Tekh. Ekspt. No. 6, 23-7(1960) Nov.-Dec. (In Russian)

A method that reduces the order of error due to parameter instability in emission detectors and radiotechnical devices is discussed. The design and performance of a device based on the method are described. (tr-auth)

7555 ON THE PROPORTIONALITY OF A COUNTER WITH PLAST-MASS SCINTILLATOR. D. V. Viktorov, S. F. Kilin, and I. M. Rozman. Pribory i Tekh. Ekspt. No. 6, 27-30(1960) Nov.-Dec. (In Russian)

The dependence of scintillation value on electron and α-particle energies in scintillators of polystyrene and polyvinyl toluene was investigated. Scintillation is proportional to electron energies at 20 to 800 kev; α-particle scintillation has a linear dependence on residual range. (tr-auth)

7556 SCINTILLATION γ SPECTROMETER WITH CHANNEL CONTROL. E. K. Bonyushkin and V. V. Spektor. Pribory i Tekh. Ekspt. No. 6, 30-4(1960) Nov.-Dec. (In Russian)

Descriptions are given of a luminescence γ spectrometer with a CsI(Tl) crystal and channel control. The spectrometer is capable of dividing close lines in a complex spectrum and separating weak activity in a strong background. The resolving power is 12.5% for $E_\gamma = 0.663$ Mev and 10.5% for $E_\gamma = 1.33$ Mev. The efficiency at $E_\gamma = 0.663$ Mev is W = 1.3%. (tr-auth)

7557 VOLT-AMPERE CHARACTERISTICS OF PLANE-PARALLEL IONIZATION CHAMBER FILLED WITH AIR AT ATMOSPHERIC PRESSURE. V. S. Shevyrev. Pribory i Tekh. Ekspt. No. 6, 35-40(1960) Nov.-Dec. (In Russian)

Experimental investigations were made of volt-ampere characteristics of ionization chambers with plane-parallel electrodes and ionization intensity range up to 10^5 r/hr. It is shown that ion diffusion influences considerably the volt-ampere characteristics when the ionization intensity is less than 10^3 r/hr and the distances between the electrodes are small. A calculation method for the volt-ampere specifications is included. (tr-auth)

7558 GAS CHERENKOV COUNTER. A. I. Babaev and L. G. Landsberg. Pribory i Tekh. Ekspt. No. 6, 40-2(1960) Nov.-Dec. (In Russian)

A gas Cherenkov counter operating with Freon-13 is described. The counter efficiency with electrons at 200 Mev is near 100%. (tr-auth)

7559 COMBINATION OF β-SPECTROMETER WITH CONTROLLED WILSON CHAMBER FOR UPPER BETA-SPECTRUM BOUNDARY INVESTIGATIONS. K. I. Lasko (Moscow State Univ.). Pribory i Tekh. Ekspt. No. 6, 42-4 (1960) Nov.-Dec. (In Russian)

A new scheme for combining a β spectrometer with a controlled Wilson chamber is suggested for investigating the upper boundaries of β spectra, searching low-intensity partial β spectra in order to determine decay schemes of radioisotopes, and studying electron scatterings. (tr-auth)

7560 NEUTRONOGRAPHIC DEVICE FOR IRT REACTOR. V. I. Goman'kov, S. N. Kasatkin, S. V. Kiselev, A. A. Loshmanov, and R. P. Ozerov (Inst. of Physical Chemistry, Academy of Sciences, USSR). Pribory i Tekh. Ekspt. No. 6, 45-8(1960) Nov.-Dec. (In Russian)

A neutron diffractometer for investigating poly- and monocrystals is described. A d-c motor supplies a continuous smooth rate of rotation of a diffractometer with a range from 3 to 216°/hr. A short description is given of the method for determining the wave lengths, λ, for monochromatic thermal neutrons. Diffraction patterns from NaCl and polycrystalline α iron are included. (tr-auth)

7561 LARGE AREA SCINTILLATION COUNTER FOR RECORDING COSMIC PARTICLES. A. T. Abrosimov (Moscow State Univ.). Pribory i Tekh. Ekspt. No. 6, 48-51(1960) Nov.-Dec. (In Russian)

The design and performance of a cosmic particle counter with a polystyrene-base scintillator is described. The detector area is 0.36 m^2. Data collected with the detector are included. (tr-auth)

7562 DEVICE FOR MEASURING THE TOTAL THICKNESS OF ALPHA-ACTIVE LAYERS. V. A. Karnaukhov and V. L. Mikheev. Pribory i Tekh. Ekspt. No. 6, 60-1 (1960) Nov.-Dec. (In Russian)

A device previously designed for preparing element 102 was used for measuring total target thicknesses of Pu^{239}, Pu^{240}, and Pu^{241}. The device is capable of recording homogeneity and measuring film thicknesses. (R.V.J.)

7563 A DEVICE FOR STUDYING ELECTRON PARAMAGNETIC RESONANCE IN SOLIDS IRRADIATED BY FAST ELECTRONS. Yu. N. Molin, A. T. Koritskiĭ, A. G. Semenov, N. Ya. Buben, and V. N. Shamshev (Inst. of Chemical Physics, Academy of Sciences, USSR). Pribory i Tekh. Ekspt. No. 6, 73-7(1960) Nov.-Dec. (In Russian)

The installation combines electron paramagnetic resonance with high-frequency magnetic field modulation, operating at a wave length of ~3.2 cm with an electron tube capable of producing electrons up to 2 Mev. The electron beam is injected into a spectrometer resonator through a cylindrical channel in one of the pole pieces of the magnet, parallel to the magnetic lines. The device is used for examining the accumulation and recombination of radicals at temperatures from −150 to +200°C and irradiations from 3×10^3 to 3×10^6 r/sec. (tr-auth)

7564 MASS SPECTROMETER RMS-2 DESIGNED FOR STUDYING CHEMICAL REACTIONS AND DETERMINING FREE RADICALS. V. L. Tal'roze, L. L. Dekabrun, G. D. Tantsyrev, E. L. Frankevich, O. D. Vetrov, A. K. Lyubimova, G. K. Lavrovskaya, V. I. Erofeev, V. D. Grishin, V. E. Skurat, and A. Ya. Yukhvidin (Inst. of Chemical Physics, Academy of Sciences, USSR). Pribory i Tekh. Ekspt. No. 6, 78-84(1960) Nov.-Dec. (In Russian)

Descriptions are given of a double magnetic mass spectrometer designed for the investigation of chemical reactions and elementary processes in which neutral and charged particles participate. The production of ions is achieved by either a recharge method or ionization of "quasimonochromatic" electrons. Gas transfer to the ion source is accomplished through the use of a modulated molecular beam, coaxial with the ion beam. The ion current was recorded by either a d-c amplifier or by preliminary current amplification by a secondary-electron amplifier. A resonance amplifier was used for recording modulated ion currents. (tr-auth)

7565 RADIOFREQUENCY MASS-SPECTROMETER FOR ION AND MOLECULAR COMPOSITION ANALYSIS IN UPPER ATMOSPHERE. V. A. Pavlenko, A. E. Rafal'son, M. E. Slutskiĭ. G. A. Tsveĭman, and M. D. Shutov (Special Bureau for Construction of Analytical Apparatus, [USSR]). Pribory i Tekh. Ekspt. No. 6, 89-95(1960) Nov.-Dec. (In Russian)

Descriptions are given of the design and construction of a mass spectrometer for examining ion and molecular compositions of the atmosphere. A nonmagnetic r-f analyzer, separating ions by their mass in relation to

energy increments in a high-frequency electrical field, is used with the spectrometer. The results are transmitted as mass spectra. Semiconducting devices, radio tubes, and small radio parts are used. Analyses are carried out within the ranges 1 to 4 and 12 to 56 mass units per 3 sec. (tr-auth)

7566 REMOTE CONTROL DEVICE FOR X RAY DIFFRACTION ANALYSIS OF RADIOACTIVE SPECIMENS. V. I. Karpukhin and V. A. Nikolaenko. Pribory i Tekh. Ekspt. No. 6, 96-8(1960) Nov.-Dec. (In Russian)

A remote-control device for use with radioactive specimens is described. The x-ray chamber is constructed on the principle of a Bragg spectrograph. Reflected rays are recorded by an ionization chamber with a background compensating amplifier. A permanent magnet is used to exclude the β background. The x-ray photograph is recorded by an automatic potentiometer. The recording scheme has a linear characteristic and an angle range of 4 to 76°. The x-ray picture of a 30 r/hr fuel element surface was recorded at 1 m distance by the device. (tr-auth)

7567 STEAM-JET COUNTER FOR CHARGED PARTICLES. V. A. Gladyshev and L. N. Katsaurov (Inst. of Physics, Academy of Sciences, USSR). Pribory i Tekh. Ekspt. No. 6, 113-14(1960) Nov.-Dec. (In Russian)

A counter with a single-stage oil diffusion pump and a particle inlet tube attached directly in the back of the steam jet outlet was designed for recording particles of ~300 kev. The performance of the counter was checked with polonium α particles with satisfactory results. (R.V.J.)

7568 AUTOMATIC MEASUREMENTS OF CHARGED PARTICLES IN SPECTROMETERS. V. V. Okorokov (Inst. of Experimental and Theoretical Physics, Academy of Sciences, USSR). Pribory i Tekh. Ekspt. No. 6, 114-15 (1960) Nov.-Dec. (In Russian)

A completely automatic method is offered for determining charged particle spectra in a spectrometer with a deflecting magnetic field. The measurements are carried out by applying an alternating magnetic field and a time analyzer (the time dial of which is synchronized with magnetic field variations). (tr-auth)

7569 ILLUMINATION SYSTEM FOR BUBBLE AND WILSON CHAMBERS. A. M. Rezikyan and K. G. Mnatsakanyan (Inst. of Physics, Academy of Sciences, Armenian SSR). Pribory i Tekh. Ekspt. No. 6, 115-18(1960) Nov.-Dec. (In Russian)

A new system for uniformly illuminating large working areas was developed. The system consists of linear sources and laminated organic glass lenses. Photometric measurements indicate not more than 8% illumination variability. (tr-auth)

7570 FORMATION OF IMAGES IN PHOTOGRAPHING PARTICLE TRACKS IN BUBBLE CHAMBERS. Yu. A. Aleksandrov, N. B. Delone, V. M. Likhachev, and V. M. Gorbunkov (Inst. of Physics, Academy of Sciences, USSR and Moscow Inst. of Physics and Tech.). Pribory i Tekh. Ekspt. No. 6, 118-19(1960) Nov.-Dec. (In Russian)

Light attenuation by a bubble is analyzed using two light sources distributed symmetrically to the axis of the objective (the bubble in a propane bubble chamber). A large-scale picture of electron tracks shows four horizontally distributed points for each bubble, one pair representing the imaginary light sources produced by the refraction zone, whereas the other pair is produced by reflection. The experiment confirms the postulation that the bubble acts as a negative lens for rays with an angle of incidence less than the total intrinsic reflection and as a convex spherical mirror for rays with large angles of incidence. (R.V.J.)

7571 THE GROWTH AND EMERGENCE RATE OF BUBBLES IN A PROPANE CHAMBER. Yu. A. Aleksandrov, N. B. Delone, V. M. Likhachev, and V. M. Gorbunkov (Inst. of Physics, Academy of Sciences, USSR and Moscow Inst. of Physics and Tech.). Pribory i Tekh. Ekspt. No. 6, 120(1960) Nov.-Dec. (In Russian)

Two illumination sources and two pulsed lamps were used in the experiment. The lamps were pulsed with consequent delays of 7, 14, 22, and 30 μsec; the growth and emergence of bubbles was measured between two ignitions. Twenty-seven events were selected from four sets of measurements with initial bubble radii of $0.10 > r_{init} < 0.20$ mm. The final magnitudes were $0.20 < r_{final} < 0.36$ mm with $C_{exp} = (5.8^{+2.6}_{-1.2}) \times 10^{-2}$; the theoretical constant was $C_{theor} = 1.7 \times 10^{-1}$. The emergence rate was 3.6×10^{-2} /msec $< W_{exp} < 11.7 \times 10^{-2}$ mm/msec; the rate of emergence is faster than the bubble growth. (R.V.J.)

7572 A REFLECTED LIGHT ILLUMINATOR FOR EXAMINING THICK-LAYER PHOTO EMULSIONS. L. G. Gasparyan, D. S. Matoyan, and E. G. Melikyan (Erivan State Univ., [USSR]). Pribory i Tekh. Ekspt. No. 6, 121 (1960) Nov.-Dec. (In Russian)

A reflection illuminator (01—21) was used in order to increase the contrast of images in an emulsion. Various small improvements in the construction of the illuminator are suggested. (R.V.J.)

7573 DEVICE FOR MEASURING PULSED MAGNETIC FIELD INTENSITIES. Yu. L. Kurkin, N. S. Kurkina, and R. D. Matsonashvili. Pribory i Tekh. Ekspt. No. 6, 122-3 (1960) Nov.-Dec.

A device for measuring pulse magnetic fields of 1 to 1000 gauss with an order of accuracy of ±2 to 3%, based on the Hall effect in a semiconductor (germanium), is described. The device is equipped with an arrow indicator and an oscilloscope. The length of the pulses is 20 μsec to 20 msec (oscilloscope) and 100 μsec to 200 msec (arrow indicator). (tr-auth)

7574 RADIO SQUELCH WITHOUT TUBES. R. L. Shaum (Sandia Corp., N. Mex.). Radio-Electronics 50-1 (1960) June. (SCR-209)

A method for adding relay squelch circuits to receivers without adding other vacuum tubes to amplify the arc voltages is described. Precautions to be taken for best results are outlined and circuit diagrams are included. (J.R.D.)

7575 A COMPARISON OF TWO FLUOROMETERS DESIGNED TO MEASURE THE RADIATION-INDUCED FLUORESCENCE OF SILVER-ACTIVATED GLASS RODS. Nathaniel F. Barr, Mary Stark, and J. S. Laughlin (Sloan-Kettering Inst. for Cancer Research, New York). Radiology 76, 113-15(1961) Jan.

7576 A P-N JUNCTION SEMICONDUCTOR RADIATION DETECTOR FOR USE WITH BETA- AND GAMMA-RAY-EMITTING ISOTOPES. N. A. Baily and J. W. Mayer (Hughes Aircraft Co., Culver City, Calif.). Radiology 76, 116(1961) Jan.

Lithium-diffused silicon P-N junction semiconductor devices showed good sensitivity to β radiation, γ radiation, and mixed emitters. Data are tabulated on the approximate sensitivity values derived experimentally with the use of dry sources having an approximate area of 1 cm^2 and a detector of 3 mm dia. (C.H.)

7577 PRACTICAL USES FOR THE RADIATION POLYMERIZATION DOSIMETER IN RADIATION THERAPY. Frank E. Hoecker (Univ. of Kansas, Lawrence). Radiology 76, 116-17(1961) Jan.

The development of new liquid polymers has extended the usefulness of the radiation polymerization dosimeter into the range of deep therapy doses. A dosimeter is described which consists of three dosimetric cells sealed in a transparent waterproof pocket. Each cell is a sealed gelatin capsule containing a dosimetric liquid and a small gas bubble. Exposure to the dose of radiation for which it was designed results in the formation of active radicals which initiate crosslinking to form an infinite network. The dosimetric end-point is detected visually by immovability of the bubble. The monitor can be used to monitor skin doses and doses to the linings of accessible cavities. The dosimeter is small in size, may be read instantaneously without auxiliary equipment, and possesses sharpness and irreversibility of end-point. (C.H.)

7578 COBALT-60 DEPTH-DOSE CORRECTION AS DETERMINED BY TRANSMISSION DOSE MEASUREMENTS. R. J. Schulz, G. A. Cohen, J. P. Tsai, and J. C. Evans (Albert Einstein Coll. of Medicine, New York and Bronx Municipal Hospital Center, New York). Radiology 76, 117-18(1961) Jan.

A simple straight-bore collimator, with standard 25-r Victoreen dosimeter, mounted to the primary beam shield of a rotating Co^{60} unit was used for depth dose measurements. The patient's transmission is determined by making one measurement during the course of treatment and another with the patient removed. The effective absorption coefficient is determined from a family of curves which relate percentage transmission and patient diameters. (C.H.)

7579 NEW SIMPLE RADIATION SCANNING SYSTEM. T. Fields, G. Clayton, and J. Kenski (Veterans Administration Hospital, Hines, Ill.). Radiology 76, 122-3(1961) Jan.

A complete single-package unit, approximately 3 in. by 12 in., containing the entire detector, amplifier, and indicating device was developed for use in scanning a radiation site with a scintillation counter. Typical scanning patterns are shown for known source geometry and thyroid phantoms. (C.H.)

7580 MASS SPECTROMETRY. D. S. Lees (Imperial Chemical Industries Ltd., Billingham, Eng.). Research (London) 14, 2-7(1961) Jan.

The principle of the mass spectrometer is described and examples of well-established uses are given. Methods for increasing the scope of the instrument are discussed, and instruments for special purposes are described. Examples are given of industrial applications both in the laboratory and in continuously operating production plants. The possibility of using a mass spectrometer in automatic control systems is discussed. (auth)

7581 HIGH DUTY CYCLE ONE-SHOT MULTIVIBRATOR CIRCUIT. Duane O. Hale (Univ. of Calif., Berkeley). Rev. Sci. Instr. 31, 1163(1960) Oct. (UCRL-9286)

A one-shot multivibrator circuit for use as a delay, gating, and pulse-shaping unit is described which is rendered capable of a 95% duty cycle by shorting one resistance so that the capacitor discharges in ~5% of the duty cycle. A schematic diagram is included. (D.L.C.)

7582 SPECTROMETER FOR NUCLEAR MAGNETIC RESONANCE IN INTERMEDIATE FIELDS. V. V. Frolov. Vestnik Leningrad. Univ. 15, No. 10, Ser. Fiz. i Khim. No. 2, 49-54(1960). (In Russian)

An apparatus for observing nuclear magnetic resonance in liquids is described. A magnetic field of 200 oersteds is created by a solenoid, the inhomogeneity being compensated by two coaxial coils. The resonance lines were observed by means of a circuit with a fully balanced bridge and an r-f phase sensitive detector. A resolution of ~7 cps at 35 oersteds is achieved, the sensitivity reaching the theoretical value for this resolution. (auth)

7583 THE PHOTOGRAPHIC DARKENING LAW FOR ELECTRON BEAMS OF VARIOUS ENERGY. R. Glocker (Technische Hochschule, Stuttgart). Z. Physik 160, 568-72(1960). (In German)

Absorbed energy is calculated for silver bromide layers which are smaller than the electron range. The proportionality between darkening and absorbed energy was determined for the energy range 0.01 to 2 Mev. Increased photographic effects were found for x radiation in the Compton range. (tr-auth)

7584 ON THE DETECTION OF SINGLE IONS IN ION-ELECTRON TRANSFORMATIONS. Fritz Bernhard, Karl Heinz Krebs, and Ingrid Rotter (Kernphysikalische Institut der Deutschen Akademie der Wissenschaften, Berlin). Z. Physik 161, 103-15(1961). (In German)

The ion detector previously described was further developed in regard to detection of single ions. It is shown that experimental conditions can be provided which permit reliable detection of a single ion per second. Compared with this, there is statistical data showing that in the use of the Allen detector for ion detection a considerable counting loss can occur. The described process can also be used to determine the number of secondary electrons released at a metal surface, per ion, for a single process. A series of measurements of secondary electron release from nickel by atomic and hydrocarbon-molecule ions is presented. (tr-auth)

7585 CHERENKOV DETECTORS. G. W. Hutchinson. p.195-236 of "Progress in Nuclear Physics. Vol. 8." New York, Pergamon Press, 1960.

A brief account of the theory of the Cherenkov effect is given, and the design and performance of recent Cherenkov counter designs are treated in detail, including beam energy monitors, threshold detectors, focusing counters, critical reflection counters, and total absorption counters. Possible use of the Cherenkov effect to obtain a pictorial representation of particle trajectories in velocity space is discussed. 59 references. (D.L.C.)

7586 ADVANCES IN THE DESIGN OF VACUUM GAUGES USING RADIOACTIVE MATERIALS. J. R. Roehrig and G. F. Vanderschmidt (National Research Corp., Cambridge, Mass.). p.82-4 of "Sixth National Symposium on Vacuum Technology; Transactions, October 7, 8, and 9, 1959, Philadelphia, Pennsylvania. New York, Pergamon Press Inc., 1959."

Tritium is advantageously used in radiological vacuum gages. The H^3 gas is absorbed in a thin layer of titanium, forming a stable compound at room temperature. Because of the complete absence of penetrating radiation, high intensity sources may be used to permit convenient measurement of pressures down to 10^{-5} mm Hg with essentially no hazard to personnel. A fundamental problem in the design of simple portable radiological vacuum gages is the difficulty of measuring the small current from such gages. A method which makes use of the time of discharge of a capacitor permits a simple direct measurement of the current; the method provides an output which is ideally suited for telemetering, and makes the gage especially useful for high-altitude meteorological measurement. (auth)

7587 IMPROVEMENTS IN OR RELATING TO IMPULSE CURRENT INSTALLATIONS. (to Siemens-Schuckertwerke A.G.). British Patent 855,584. Dec. 7, 1960.

An impulse current installation is designed with an impulse amplitude of ~10^6 amp and current rise rates of ≥10^{12} amp/sec. In this installation, high-voltage condensers are discharged through a discharge vessel which is surrounded by coaxial cylindrical housings arranged to carry the discharge current. The sections of the installation are readily detachable so that conditions can easily be varied for thermonuclear experiments. (D.L.C.)

7588 APPARATUS FOR DETECTING AND RECORDING RADIOACTIVITY. Robert Earl Fearon (to Well Surveys Inc.). British Patent 855,974. Dec. 14, 1960.

A scintillation detector for use at elevated temperatures such as those in well logging is designed in which the scintillator is a gas compressed at ~300 psi. The photosensitive surface is made of material that does not melt at borehole temperatures and has a high electronic work function. Gas amplification is used in place of an electron multiplier. Gases suitable for use in such a detector up to 400°F are the inert gases as such or mixed with mercury vapor. Photosensitive materials remaining solid at 400°F and having a threshold between 1500 and 4000 A are Cu, Ni, Pt, Au, Ag, and W. Gas amplification is accomplished with a low-pressure proportional counting gas such as H_2, Ar, He, etc. Drawings are presented for the application of this detector to well logging and for various detector modifications, e.g., for coincidence counting and scintillation focusing. (D.L.C.)

7589 IMPROVEMENTS IN OR RELATING TO APPARATUS FOR MEASURING THE AMOUNT OF URANIUM CONTAMINATION ON THE OUTER SURFACES OF FUEL ELEMENTS. John William George Gregory and Richard Bruce Owen (to United Kingdom Atomic Energy Authority). British Patent 857,005. Dec. 21, 1960.

An α counting apparatus for measuring α emission from the outer surfaces of fuel elements is designed so that the counting is done in a shorter time than heretofore. The apparatus comprises an electrode system containing argon in which a constant gas flow past the element is maintained by a leak valve. Interference is largely eliminated by means of a guard electrode and the apparatus design and construction. (D.L.C.)

7590 IMPROVEMENTS IN OR RELATING TO MAGNETIC CORE ASSEMBLIES. Ernest Franklin (to United Kingdom Atomic Energy Authority). British Patent 857,269. Dec. 29, 1960.

A magnetic core assembly of very small volume may be designed with close coupling of the windings to the core by constructing the core as a cylinder or a ring rather than a plate. According to this invention, the core consists of a copper rod or ring on which a nickel-iron sheet or film (magnetic material) and then windings are attached. The core assembly resists magnetic flux changes within the core and can be used in inductors, transformers, memory elements, and other circuit applications dealing with short pulses. (D.L.C.)

7591 IMPROVEMENTS RELATING TO THE MEASUREMENT OF THE QUANTITY OF INCIDENT IONISING RADIATION. Rolf Maximilian Sievert. British Patent 857,610. Jan. 4, 1961.

A radiation detection instrument which measures the quantity of ionizing radiations received over a known period of time is designed in which the radiation builds up an electric charge on an insulated electrode of an ionization chamber over the period, and then the charge is transferred in small increments from the electrode to an output circuit with an indicating device via an insulated body of electric capacity a fraction of that of the electrode. The number of times (clicks if a vacuum amplifier tube connected to a loudspeaker is used) then gives the number of times the output circuit is used and is a measure of the total dose. (D.L.C.)

7592 METHOD AND APPARATUS FOR GAS DETECTION. (to Mine Safety Appliances Co.). British Patent 857,631. Jan. 4, 1961.

A simple method for detecting and measuring minute quantities of an electronegative gas in a nonelectronegative carrier gas is described which uses an ionization chamber with continuous gas flow; the presence of an electronegative gas reduces the ionization current of a nonelectronegative gas in proportion to its concentration. This method has been used successfully to detect oxygen in amounts as low as 10 ppm in hydrogen, ethylene, and methane. Drawings are included which show diagrammatically an electric circuit for measuring ionization current changes in an ionization chamber and two embodiments of this method using a second ionization chamber with an oxygen removal element as a compensator chamber. (D.L.C.)

7593 IMPROVEMENTS IN OR RELATING TO INTEGRATING DOSIMETERS. George Donald Smith (to Plessey Co., Ltd.). British Patent 857,762. Jan. 4, 1961.

An integrating dosimeter is designed comprising a radiation detector, e.g., an ionization chamber, a capacitor, an electrometer valve, a trigger circuit, and an electromechanical register. In operation, the ionization current charges the capacitor, leading to a voltage proportional to the integrated dose; as soon as this voltage equals the bias voltage of the trigger circuit, the register reading is advanced by one digit and the capacitor is discharged. In this way, it is not necessary to know beforehand the magnitude of the dose to be measured. Circuit diagrams are presented for one embodiment of this invention and for a suitable trigger circuit. (D.L.C.)

7594 IMPROVEMENTS IN OR RELATING TO MEASURING INSTRUMENTS. Raymond John Cox and Hugh Sutherland Macadie (to United Kingdom Atomic Energy Authority). British Patent 858,722. Jan. 11, 1961.

A measuring instrument with a pivoted pointer arranged to sweep over a graduated scale is designed with a light bulb, photosensitive transistors, and vanes attached on the pointer so that location of the pointer at one place on the scale will block the light path to the transistors, putting into operation a subsequent circuit; such an instrument can operate the shut-down circuits of a reactor if reactor power exceeds a predetermined value. This instrument as described is of the fail-safe type, since failure of either a transistor or the lamp as well as pointer location will operate the subsequent circuit. Drawings are included illustrating two embodiments of the invention for operating the subsequent circuit at zero and full-scale positions and at three points on the scale. (D.L.C.)

7595 IMPROVEMENTS IN OR RELATING TO CAPACITORS. Roland James Peterson (to United Kingdom Atomic Energy Authority). British Patent 859,183. Jan. 18, 1961.

A high-voltage, low-value capacitor is designed which has a reduced tendency to crack. The capacitor is formed by making the plates of a plastic material, e.g., Araldite,

coating the plates with a conducting layer, and embedding the coated plates in a block of plastic material having the same temperature coefficient of expansion as the plates. (D.L.C.)

7596 IMPROVEMENTS IN OR RELATING TO LOGIC CIRCUITS. (to Westinghouse Electric Corp.). British Patent 859,306. Jan. 18, 1961.

A logic circuit is designed with radiation sources and radiation detectors so that it functions as an electroradiated relay to control a load current in a switching mode. In this circuit, a first radiation detector across a load is controlled by a radiation source which in turn is controlled by a plurality of second radiation detectors electrically connected to the source. All three types of logic circuits, AND, OR, and NOR, are used. (D.L.C.)

7597 IMPROVEMENTS IN OR RELATING TO TRANSISTOR CIRCUITS. George Brian Barrie Chaplin (to United Kingdom Atomic Energy Authority). British Patent 859,322. Jan. 18, 1961.

A transistor clamping circuit is designed in which drifts due to leakage currents are reduced. The circuit comprises a transistor with its collector connected to a fixed potential, its base connected to a switching terminal so that a switch of the base potential from the fixed potential can be done only in the direction which brings the transistor into conduction, and its emitter connected to output and input. (D.L.C.)

7598 ANALOG-TO-DIGITAL DATA CONVERTER. G. W. Rodgers, J. E. Althouse, D. P. Anderson, G. R. Bussey, and L. H. Minnear (to U. S. Atomic Energy Commission). U. S. Patent 2,952,012. Sept. 6, 1960.

Electrical apparatus is described, particularly useful in telemetry work, for converting analog signals into electrical pulses and recording them. An electronic editor commands the taking of signal readings at a frequency which varies according to linearity of the analog signal being converted. Readings of information signals are recorded, along with time base readings and serial numbering, if desired, on magnetic tape and the latter may be used to operate a computer or the like. Magnetic tape data may be transferred to punched cards.

7599 RANGE INCREASER FOR PNEUMATIC GAUGES. A. H. Fowler and G. B. Seaborn, Jr. (to U. S. Atomic Energy Commission). U. S. Patent 2,953,918. Sept. 27, 1960.

An improved pneumatic gage is offered in which the linear range has been increased without excessive air consumption. This has been accomplished by providing an expansible antechamber connected to the nozzle of the gage so that the position of the nozzle with respect to the workpiece is varied automatically by variation in pressure within the antechamber. This arrangement ensures that the nozzle-to-workpiece clearance is maintained within certain limits, thus obtaining a linear relation of air flow to nozzle-to-workpiece clearance over a wider range.

7600 MASS SPECTROMETER LEAK. W. R. Shields (to U. S. Atomic Energy Commission). U. S. Patent 2,956,771. Oct. 18, 1960.

An improved valve is described for precisely regulating the flow of a sample fluid to be analyzed, such as in a mass spectrometer, where a gas sample is allowed to "leak" into an evacuated region at a very low, controlled rate. The flow regulating valve controls minute flow of gases by allowing the gas to diffuse between two mating surfaces. The structure of the valve is such as to prevent the corrosive feed gas from contacting the bellows which is employed in the operation of the valve, thus preventing deterioration of the bellows.

7601 METHOD AND MEANS FOR RADIATION DOSIMETRY. John W. Schulte and John F. Suttle (to U. S. Atomic Energy Commission). U. S. Patent 2,957,080. Oct. 11, 1960.

A precise dosimeter design is given for γ and x-rays. The amount of "sensitizer" present in a halogenated hydrocarbon system is controlled so as to achieve a reproducible response to radiation. The sensitizer in this patent is a leuco base of certain dyestuffs.

7602 SCINTILLATION EXPOSURE RATE DETECTOR. W. G. Spears (to U. S. Atomic Energy Commission). U. S. Patent 2,958,779. Nov. 1, 1960.

A radiation detector for γ and x rays is described. The detector comprises a scintillation crystal disposed between a tantalum shield and the input of a photomultiplier tube, the crystal and the shield cooperating so that their combined response to a given quantity of radiation at various energy levels is substantially constant.

7603 PULSED INDICATOR CIRCUIT. W. I. Linlor and Q. A. Kerns (to U. S. Atomic Energy Commission). U. S. Patent 2,960,653. Nov. 15, 1960.

A system is given for detecting incremental changes in a transducer impedance terminating a transmission line. Principal novelty resides in the transducer impedance terminating the line in a mismatch and a pulse generator being provided to apply discrete pulses to the input end of the line. The amplitudes of the pulses reflected to the input end of the line from the mismatched transducer impedance are then observed as a very accurate measure of the instantaneous value of the latter.

7604 ELECTRONIC SYSTEM. Gerson H. Robison, et al. (to U. S. Atomic Energy Commission). U. S. Patent 2,960,687. Nov. 15, 1960.

An electronic system is described for indicating the occurrence of a plurality of electrically detectable events within predetermined time intervals. It is comprised of separate input means electrically associated with the events under observation; an electronic channel associated with each input means including control means and indicating means; timing means associated with each of the input means and the control means and adapted to derive a signal from the input means and apply it after a predetermined time to the control means to effect deactivation of each of the channels; and means for resetting the system to its initial condition after observation of each group of events.

7605 MULTI-CHANNEL ELECTRIC PULSE HEIGHT ANALYZER. James D. Gallagher, et. al. (to U. S. Atomic Energy Commission). U. S. Patent 2,961,159. Nov. 22, 1960.

An apparatus is given for converting binary information into coded decimal form comprising means, in combination with a binary adder, a live memory and a source of bigit pulses, for synchronizing the bigit pulses and the adder output pulses; a source of digit pulses synchronized with every fourth bigit pulse; means for generating a conversion pulse in response to the time coincidence of the adder output pulse and a digit pulse; means having a delay equal to two bigit pulse periods coupling the adder output with the memory; means for promptly impressing said conversion pulse on the input of said memory; and means having a delay equal to one bigit pulse period for again impressing the conversion pulse on the input of the memory whereby a

fourth bigit adder pulse results in the insertion into the memory of second, third and fourth bigits.

7606 RADIO ALTIMETERS. R. W. Bogle (to U. S. Atomic Energy Commission). U. S. Patent 2,961,652. Nov. 22, 1960.

A radio ranging device is described which utilizes a superregenerative oscillator having alternate sending and receiving phases with an intervening ranging interval between said phases, means for varying said ranging interval, means responsive to an on-range noise reduction condition for stopping said means for varying the ranging interval and indicating means coupled to the ranging interval varying means and calibrated in accordance with one-half the product of the ranging interval times the velocity of light whereby the range is indicated.

7607 RADIO RANGING DEVICE. R. W. Bogle (to U. S. Atomic Energy Commission). U. S. Patent 2,961,653. Nov. 22, 1960.

A description is given of a super-regenerative oscillator ranging device provided with radiating and receiving means and being capable of indicating the occurrence of that distance between itself and a reflecting object which so phases the received echo of energy of a preceding emitted oscillation that the intervals between oscillations become uniform.

7608 NEUTRON-COUNTER. S. B. Gunst and R. T. Bayard (to U. S. Atomic Energy Commission). U. S. Patent 2,965,781. Dec. 20, 1960.

A heat- and pressure-resistant radiation counter adaptable to the counting of thermal neutrons comprising a spheroidal chamber electrode having a coating of fissionable material and containing a spherical electrode is described.

7609 METAL RESISTIVITY MEASURING DEVICE. J. Renken, Jr. and Ronald G. Myers (to U. S. Atomic Energy Commission). U. S. Patent 2,965,840. Dec. 20, 1960.

An eddy current device is offered for detecting discontinuities in metal samples. Alternate short and long duration pulses are inductively applied to a metal sample via the outer coil of a probe. The long pulses give a resultant signal from the metal sample responsive to probe-to-sample spacing and discontinuities within the sample and the short pulses give a resultant signal responsive only to probe-to-sample spacing. The inner coil of the probe detects the two resultant signals and transmits them to a separation network where the two signals are separated. The two separated signals are then transmitted to a compensation network where the detected signals due to the short pulses are used to compensate for variations due to probe-to-sample spacing contained in the detected signals from the long pulses. Thus, a resultant signal is obtained responsive to discontinuities within the sample and independent of probe-to-sample spacing.

7610 DEFLECTION PRESSURE TESTER. C. M. Cooper (to U. S. Atomic Energy Commission). U. S. Patent 2,966,794. Jan. 3, 1961.

A method and apparatus for determining whether the jacket of a nuclear-fuel slug has a leak are described. The region of the jacket to be leak-tested is sealed off, and gas under pressure is applied thereto. If there is an imperfection, the gas will enter the jacket and bulge another region of the jacket. The bulge occurring is measured by a gage.

7611 SENSITIVE PRESSURE GAUGE. W. P. Ball (to U. S. Atomic Energy Commission). U. S. Patent 2,966,799. Jan. 3, 1961.

An electron multiplier device is described. It has a plurality of dynodes between an anode and cathode arranged to measure pressure, temperature, or other environmental physical conditions that proportionately influences the quantity of gas molecules between the dynodes. The output current of the device is influenced by the reduction in electron multiplication at the dynodes due to energy reducing collisions of the electrons with the gas molecules between the dynodes. More particularly, the current is inversely proportional to the quantity of gas molecules, viz., the gas pressure. The device is, hence, extremely sensitive to low pressures.

7612 AUTOMATIC FREQUENCY CONTROL SYSTEM. C. F. Hansen and J. D. Salisbury (to U. S. Atomic Energy Commission). U. S. Patent 2,968,007. Jan. 10, 1961.

A control is described for automatically matching the frequency of a resonant cavity to that of a driving oscillator. The driving oscillator is disconnected from the cavity and a secondary oscillator is actuated in which the cavity is the frequency determining element. A low frequency is mixed with the output of the driving oscillator and the resultant lower and upper sidebands are separately derived. The frequencies of the sidebands are compared with the secondary oscillator frequency, deriving a servo control signal to adjust a tuning element in the cavity and matching the cavity frequency to that of the driving oscillator. The driving oscillator may then be connected to the cavity.

7613 BETA-GAMMA PERSONNEL DOSIMETER. D. M. Davis, E. D. Gupton, J. C. Hart, and A. P. Hull (to U. S. Atomic Energy Commission). U. S. Patent 2,968,731 Jan. 17, 1961.

A personnel dosimeter is offered which is sensitive to both γ and soft β radiations from all directions within a hemisphere. The device is in the shape of a small pill box which is worn on a worker's wrist. The top and sides of the device are provided with 50 per cent void areas to give 50 per cent response to the β rays and complete response to the γ rays. The device is so constructed as to have a response which will approximate the dose received by the basal layer of the human epidermis.

Materials Testing

7614 (ARF-6043-14) ULTRASONICS AND CERAMIC COATINGS. Quarterly Progress Report No. 3 [for] October 1–December 30, 1960. W. E. Lawrie (Illinois Inst. of Tech., Chicago. Armour Research Foundation). Jan. 9, 1961. 21p. Contract AF33(616)-6396.

The results of low frequency decrement measurements confirmed that defects in a ceramic-metal bond at the center of a longitudinally vibrating specimen destroys the smooth decay of oscillatory motion that normally occurs when the excitation is removed. Similar measurements showed that flexurally vibrating spring steel strips coated with zirconium oxide do not provide a correlation between bond condition and prestress. Improvements were made to the charge scanning equipment and further tests showed that the technique can detect simulated defects down to $\frac{1}{32}$-in. diameter. Combination of the charge scanning and perturbation of defect methods did not prove successful. Surface wave measurements using a 0.003-in. porcelain coated specimen confirmed that absorption rather than interference is responsible for poor results using the immersion surface wave equipment with zirconium oxide. (W.L.H.)

7615 (CEA-1449) APPAREIL DE RADIOCRISTALLOGRAPHIE POUR EXAMENS DE MATERIAUX IRRADIES. (A Radiocrystallographic Apparatus for the Examination of Irradiated Materials). J. Bloch (France. Commissariat à l'Énergie Atomique. Centre d'Études Nucléaires, Saclay). 1960. 23p.

A description is given of a radiocrystallographic apparatus designed for the examination of irradiated metals. The double-diffraction method was used. A monochromator is placed in the beam of x rays diffracted by the sample, thus enabling lead shielding to be interposed between the sample and the counter. In this way a very large proportion of the radiation due to the activity of the sample is eliminated. By this method substances with activities of the order of several tens of curies may be examined, and the relative precision obtained in measurements of parameters with this apparatus is equal to 10^{-4} in the case of good crystals. (auth)

7616 (HW-65910) A MULTIPLE NONDESTRUCTIVE TEST STATION FOR NPR FUEL ELEMENTS. T. G. Lambert (General Electric Co. Hanford Atomic Products, Richland, Wash.). June 28, 1960. 33p. Contract AT (45-1)-1350.

A prototype nondestructive test station was developed to inspect NPR fuel. Eddy currents are induced in the zirconium cladding at 20 and 120 kc. At the lower frequency, cladding thickness is measured to within approximately ±0.002 in. The higher frequency reveals discontinuities which reduce the cladding's protection against water entry. Simultaneously, the behavior of 15-mc ultrasonic waves traveling across the zirconium–uranium interface is analyzed to assure bond integrity. If the bond is good, ultrasonic energy enters the uranium to reveal defects which may be situated in the target material. In the absence of internal defects, the rate of ultrasonic wave decay is observed and provides a measurement of uranium average grain diameter. Methods of extending the nondestructive inspections to include fuel-element closures are presently under development. (auth)

7617 (SB-411) MATERIALS TESTING (1950–1960). OTS SELECTIVE BIBLIOGRAPHY. (Office of Technical Services, Washington, D. C.). May 1960. 16p.

Reports are arranged in categories as follows: Nondestructive Testing; Ultrasonic Testing; Autoradiographic and Radiographic Testing; and Materials Testing, General. (auth)

7618 DEVELOPMENT OF A RADIOACTIVE AEROSOL FOR TESTING FILTER FABRICS. J. K. Skrebowski and B. W. Sutton (Imperial Chemical Industries Ltd., Billingham, Eng.). Brit. Chem. Eng. 6, 12-15(1961) Jan.

A radioactive aerosol was developed for measuring the efficiency of dry filter media. The aerosol particles labeled with P^{32} as KH_2PO_4 were size analyzed, and their mass median size was found to be 0.3 micron, with no particles greater than 1.2 micron. The technique used for measuring the efficiencies is described; it is easy and safe, and the reproducibility is good. The technique is applicable to numerous problems in the field of dust filtration, both in the laboratory and on the plant. (auth)

7619 THERMAL CYCLING RIGS FOR NUCLEAR REACTOR FUEL ELEMENTS. METHODS OF APPLYING MECHANICAL LOAD. J. R. Linge (Kings Coll., England). Engineer 28, 1093-8(1960) Dec. 30

Some of the problems associated with the design of equipment for thermal cycling tests on nuclear reactor fuel elements of the Calder Hall type are described with special reference to the development of devices for applying loads to the fuel element assemblies. For reference purposes the theoretical solution, indicating optimum dimensions for the design, is given in an appendix. Mention is made of a test rig which might be used to simulate the aerodynamic torque loads experienced by certain types of fuel element in a reactor channel. It would appear that the novel method of applying end load described might well be applicable to other fields of test and investigation. (auth)

7620 IRRADIATION TECHNIQUES FOR FISSILE MATERIALS—1. O. S. Plail (Atomic Energy Research Establishment, Harwell, Berks, England). Nuclear Power 5, 91-96(1960) Dec.

Three methods for irradiation testing fissile materials are described: full-size fuel-element testing in a power or production reactor, accelerated testing using dynamic loops in a test reactor, and small-scale irradiations when environmental conditions are of secondary importance. Factors involved in choosing specimen parameters and general rig design are discussed. A review of early designs and a survey of irradiation programs now in progress are also included. (M.C.G.)

GEOLOGY, MINERALOGY, AND METEOROLOGY

7621 (HW-67390) EVALUATION OF RADIOLOGICAL CONDITIONS IN THE VICINITY OF HANFORD, JULY–SEPTEMBER 1960. R. L. Junkins, E. C. Watson, I. C. Nelson, G. E. Backman, and R. C. Henle (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Nov. 10, 1960. 46p. Contract AT(45-1)-1350.

Little change was seen in the annual radiation dose to persons residing in the neighborhood of the Hanford controlled area. The estimated dose for these persons remains at 10 to 15 per cent of that recommended by the National Committee on Radiation Protection. The primary source of the radioactivity that causes the major portion of the radiation dose to persons residing in the neighboring area of Hanford continues to be reactor coolant water which empties into the Columbia River. The subsequent consumption of sanitary water derived from the river by downstream communities is the primary mode of radiation exposure. Iodine-131 released to the atmosphere in the third quarter of 1960 by separations facilities was higher by a factor of 2.5 than in any like period in 1959 or the first half of 1960. There is no indication that any significant exposure to any persons or grazing animals resulted from this increase. Measurements of radioactive particle concentrations in the atmosphere indicate very little change in the third quarter of 1960 when compared with the second quarter. There is a slight decrease in the number of particles found in the third quarter of 1960 as compared to the third quarter of 1959. Sample results of vegetation and farm products are consistent with those reported for the past two quarters. (auth)

7622 (NP-9783) RADIOACTIVE FALLOUT IN ISRAEL. PART 1. MEASUREMENT OF THE TOTAL DEPOSITED ACTIVITY AND OF THE RADIOACTIVITY OF THE AIR. Final Report for 1958 and 1959. J. R. Gat and J. Gilat (Israel. Atomic Energy Commission, Tel-Aviv). July 1960. 152p. (IA-571)

The fall-out of radioactive debris from nuclear bomb

tests was collected at seven stations throughout Israel during 1958 and 1959, and its β activity and decay properties determined. Fall-out levels followed the same average trends at all stations. Activity peaks found throughout 1958 could be related to the nuclear tests conducted during that year. In addition to this effect, increased amounts of old fall-out were noticed during the spring of 1958 and 1959. The activity collected during 1958 was generally of mixed origin. However, the activity peak of spring 1959 could be related almost entirely to the October 1958 Russian test series. Fresh fall-out was found to be predominantly in the form of a number of hot spots while older material was more homogeneously distributed. Rain was found to be the main deposition agent, although in a manner complex to analyze. The decay properties of the fall-out were found to be reliable indicators for identifying nuclear clouds and tracing the movement of air masses. (auth)

7623 (NYO-3941) VARIATIONS IN ISOTOPIC ABUNDANCES OF STRONTIUM, CALCIUM, ARGON AND RELATED TOPICS. Eighth Annual Progress Report for 1960. (Massachusetts Inst. of Tech., Cambridge). Dec. 1, 1960. 294p. Contract AT(30-1)-1381.

The general geological importance of variations of radiogenic Sr^{87} was investigated. Studies are reported on mineral and rock ages at Sudbury-Blind River, Ontario. The relation was investigated of discordant Rb–Sr whole-rock, mica, and K-feldspar ages in an igneous rock to its time of crystallization and to the time of subsequent Sr^{89}/Sr^{86} metamorphism. The Rb–Sr age study of tektites and the Rb/Sr ratio of crustal rocks and the isotopic composition of strontium in basalt were studied. An investigation was made of the redistribution of radiogenic Sr^{87} between rubidium-rich and rubidium-poor phases during metamorphism. The sources of error in the preparation of spike and shelf solutions for geochronometric work were investigated. Potassium-argon age measurements on illite from well-dated paleozoic shales and on concentrates of 2M, mica, and $1M_d$ illite from a Pennsylvanian shale are reported. The removal of part of the potassium and argon in a silurian illite by molten lithium nitrate treatment is reported. A study was made of the age of K-phases in deep ocean sediments. Age measurements are reported for the Grenville metamorphism near Dolbeau, province of Quebec. The age of sylvite from Palangana Salt Dome, Duval County, Texas, was investigated. Mineral and whole-rock ages were determined for Massachusetts granitic rocks. (W.L.H.)

7624 (SC-4493(RR)) ENVIRONMENTAL BETA-GAMMA RADIOACTIVITY IN AIR AT SANDIA LABORATORY, APRIL THROUGH NOVEMBER 1958. R. E. Womelsduff and A. Juskiewicz (Sandia Corp., Albuquerque, N. Mex.). Dec. 1960. 21p.

Data are presented on the gross β-γ radioactivity (expressed as disintegrations per minute per cubic meter of air) of air samples collected by the Industrial Hygiene Division of the Sandia Laboratory of Sandia Corporation during the period indicated in 1958. (auth)

7625 (JPRS-6626) PROCEEDINGS OF THE SECOND INTER-INSTITUTE CONFERENCE ON THE PROBLEM OF MICROELEMENTS AND NATURAL SOIL RADIOACTIVITY IN THE USSR. R. M. Aleksakhin and V. D. Vasilevskaya (Vasil-yevskaya). Translated from Pochvovedenie No. 9, 114-15(1960). 5p.

The conference was devoted to a review of recent work in this field. Eighty-eight papers were read and discussed covering results of studies in soil science, plant physiology, agricultural chemistry, natural soil radioactivity, and methods for determining microelements in soils and plants. A brief summary is presented of some of the papers. (C.H.)

7626 RECENT DATA ON ZIRCONOLITE AND ITS NIOBIUM VARIETY. L. S. Borodin, A. V. Bykova, T. A. Kapitonova, and Yu. A. Pyatenko (Inst. of Mineralogy, Geochemistry and Crystallochemistry of Rare Elements, Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R. 134, 1188-91(1960) Oct. 11. (In Russian)

Zirconolite of mineral composition $CaZrTi_2O_7$ was found in amphibolized pyroxenites in the Cola Peninsula. Intrusions of 2 to 3 cm of zirconolite, accompanied by apatite and ilmenite, were observed in large grain mica pyroxenite. The mineral is iron black with a reddish brown cast, has irregular fracture, adamantive luster, index of diffraction 2.5, hardness ~6, and specific weight 4.37. The chemical content of Aldan deposit zirconolite, developed with a cation ratio to oxygen of 4.07 : 7, is $(Ca_{0.80}Fe^{2+}_{0.15}TR_{0.08})_{1.04}Zr_{1.06}(Ti_{1.83}Al_{0.16}Fe^{3+}_{0.16}Nb_{0.12})_{1.97}O_7$. The chemical formula of pyrochlore and zirconolite $CaNaNb_2(O,F)_7$ and $CaZrTi_2O_7$ are quite similar. The niobium variety of zirconolite, niobozirconolite, is expressed by the formula: (Ca, Zr, Fe^{2+})$_2$(Ti, Nb, Zr)$_2O_7$ with Ca : Zr ≈ 1 : 1. The specific weight of niobozirconolite is 4.51, cell parameter a is of cubic phase and = 5.03A. The transition of ZrO_2 from zirconium pyrochloride to niobozirconolite and zirconolite has not yet been determined. (R.V.J.)

7627 SPECIFIC FALL-OUT ACTIVITY IN PRECIPITATION AS A FUNCTION OF SAMPLING HEIGHT. A. Aarkrog (Danish Atomic Energy Commission, Risö). Nature 188, 482-3(1960) Nov. 5.

At eight elevations from 7 to 123m monthly samples were obtained for the period March to December 1959. Each sample was radio-analyzed for Sr^{90}, Sr^{89}, Cs^{137}, and Ce^{144}. A tabulation is given of the specific activities of the isotopes for each elevation during the 10-month period. A regression analysis of the results shows for all the isotopes an increase in specific activity with the height. The increase in activity per 100 meters is 15% for Sr^{90}, 19% for Cs^{137}, 27% for Ce^{144}, and 31% for Sr^{89}, and an increase of 13% per 100m for the Sr^{89}/Sr^{90} ratio. The present results indicate that it is possible to detect a change in the specific activity in precipitation even within a difference in elevation of 100 meters. (B.O.G.)

7628 TREND OF CAESIUM-137 IN THE EFFLUENT OF A LARGE CITY. T. R. Folson (Scripps Institution of Oceanography, La Jolla, Calif.) and G. J. Mohanrao. Nature 188, 979-82(1960) Dec. 17.

Several radioactivities in sewage flowing from Los Angeles, California, were monitored at the treatment plant for more than two years. Cesium-137 was followed in detail and the average and peak outputs from the city were recorded over 21 months. Estimates were made of the influence of Cs^{137} on the radioactivity of coastal waters. Data were compared with reported contamination of human food by fall-out. Data are presented on the trend of Cs^{137} concentration over the 21 months derived from 75 composited samples, a comparison of influent and fertilizer concentrations, and Cs^{137} to potassium ratio in raw sewage and fertilizer. It is suggested that monitoring of the β-γ activities in sewage systems might provide additional safeguards to the public against misuse of radioactive materials. Cesium-137 activity may be used to follow the local dispersal of sewage by the ocean only if the most sensitive counting methods are used. (C.H.)

7629 EVIDENCE OF QUASI-PERPENDICULAR PROPAGATION OF HYDROMAGNETIC WAVES CAUSED BY NUCLEAR EXPLOSIONS OVER JOHNSTON ISLAND. H. Maeda and T. Ondoh (Kyoto Univ.). Nature 188, 1018-19 (1960) Dec. 17.

Evidence is presented which supports the suggestion that the initial phase of artificial magnetic storms due to high-altitude nuclear explosions over Johnston Island may be interpreted by hydromagnetic wave propagation. Replotted recordings are presented of the induction magnetograph around 10h, 50m, GMT on August 1, 1958, and around 10h, 30m, GMT on August 12, at Shimosato and Onawowa in Japan. Examination of the magnetic traces shows peculiar changes around the explosion time each day. The changes seem to consist of two parts, the first and second arrivals, and each lasts about 30 sec. An almost complete similarity between the changes on both days at each station seems to provide evidence that these changes are the direct effect of the Johnston Island explosions. (C.H.)

7630 TUNGSTEN-185 FROM NUCLEAR BOMB TESTS AS A TRACER FOR STRATOSPHERIC METEOROLOGY. Herbert W. Feely and Jerome Spar (Isotopes, Inc., Westwood, N. J.). Nature 188, 1062-4(1960) Dec. 24.

A model is presented for stratospheric mixing and transfer which is based on measurements of W^{185} in the stratosphere following the 1958 Hardtack tests. (C.H.)

7631 EXPOSURE AGES FOR IRON METEORITES. H. Wänke (Max-Planck-Institut für Chemie, Mainz). Nature 188, 1101-2(1960) Dec. 24.

Values for the exposure ages for iron meteorites are discussed. The exposure age is defined as the time during which the meteorites were exposed to cosmic rays after having been broken out of a bigger body. The ages of 18 iron meteorites were calculated to be between 2×10^7 and 1.9×10^9 years. Errors in the method used are pointed out. (C.H.)

7632 CAESIUM-137 FALL-OUT OVER NORWAY SINCE SEPTEMBER 1956. T. Hvinden, D. Hveding, A. Lillegraven, and S. H. Small (Norwegian Defence Research Establishment, Kjeller, Norway). Nature 188, 1177-8(1960) Dec. 31.

Data are presented on gross β activities and Cs^{137} concentrations in samples of precipitation collected in Norway between September 1956 and June 1960. The Cs^{137} activity followed the same general pattern as the over-all deposition of β-emitting isotopes. By comparing Cs^{137} activities with gross β-activities it was possible to obtain an idea of the effective ages of the deposited materials. It is concluded that a large part of the fall-out from many test explosions has been rather continuous over months instead of years. (C.H.)

7633 NATURAL OCCURRENCE OF SAMARIUM-146. Ronald D. Macfarlane (Univ. of California, Berkeley). Nature 188, 1180-1(1960) Dec. 31.

An 89-mg sample (approximately 45 $\mu g/cm^2$) of samarium oxide enriched in Sm^{146} was counted for a period of 64 hr. The α-particle spectrum obtained is shown. Only the Sm^{147} peak was prominent; there was no significant indication of the presence of second peak in the vicinity of 2.5 Mev. Using the value of the half life of 5×10^7 years obtained by Seaborg and Dunlavey, an upper limit of 2×10^{-7} per cent for the isotopic abundance of Sm^{146} in natural samarium was calculated. (auth)

7634 THE CROONIAN LECTURE. RADIOCARBON DATING AND QUATERNARY HISTORY IN BRITAIN. H. Godwin (Univ. Subdepartment of Quaternary Research, Cambridge, Eng.). Proc. Roy. Soc. (London) B153, 287-320(1961) Jan. 3.

An attempt is made to show the way in which research upon the Quaternary Period in Britain is being affected by the application to it of radiocarbon dating. Mild interstadial periods during the last glaciation can be distinguished, set in sequence, and related to similar European interstadials. It is shown that a brief climatic oscillation occurs widely in the Late-glacial transition from Full-glacial to Post-glacial time, and that the vegetational changes registered in pollen zonations of the Post-glacial Period are to some degree synchronous. They reflect widespread climatic changes, as do major horizons in bog stratigraphy that can also be correlated by radiocarbon dating. The method has a most powerful application to archaeology and it promises some resolution of the complex interaction of eustatic, isostatic and tectonic factors that have affected those relative movements of land and sea level recorded by the submerged forests, estuarine formations, and raised beaches of the British Isles. Between the results of British Quaternary study in these and other fields there is developing considerable consistency of pattern, as also between British Quaternary History and that of other parts of the world. 64 references. (auth)

7635 PROTACTINIUM-231 CONTENT OF OCEAN WATER AND SEDIMENTS. William M. Sackett (Scripps Inst. of Oceanography, LaJolla, Calif.). Science 132, 1761-2(1960) Dec. 9.

By means of a direct method for determining Pa^{231}, a deficiency in ocean water was found to be accompanied by unsupported Pa^{231} in ocean sediments. Protactinium-ionium ratios obtained for a surface and a deep section in the same equatorial core yielded apparent ages which were in agreement with predicted ages. (auth)

7636 BLUE HALITE. Calhoun L. H. Howard and Paul F. Kerr (Columbia, Univ., New York). Science 132, 1886-7(1960) Dec. 23.

Remarkable deep blue and occasionally purple forms of halite (rock salt) have long been known. These occur associated with potassium minerals in the Zechstein basin of northern Germany, elsewhere in Europe and in North America. In recent studies, data were developed which confirm the hypothesis that this coloration in natural salt may be attributed to γ-ray bombardment by associated K^{40} from sylvite, accompanied or followed by structural deformation. (auth)

7637 GEOLOGICAL INTERPRETATION OF AERO-RADIOMETRIC DATA. A. F. Gregory. Can., Dept. Mines and Tech. Surveys, Geol. Survey Bull. No. 66, (1960) 39p. $0.50.

Distinct contrasts in γ radioactivity exist between various materials on the surface of the earth. These contrasts may be mapped with sensitive airborne detectors. Because of the many variables involved, the interpretation of radioactivity patterns so obtained is qualitative and very general. The present theoretical study and its application to field measurements with integrating detectors resulted in a new quantitative technique for the interpretation of regional geology. The theory of attenuation of γ flux suggests that for multiple scattering conditions, certain generalizations may be made which permit a simpler assessment of flux variations than is required by the established complex mathematical treatment. The major determinants of γ flux density are the air distance between the source and the detector, the effective radiating area of the source, and the

specific surface activity of the source material. Over large air distances, the multiple-scattered radiation approximates a state of spectral equilibrium, and the attenuation of this equilibrium flux may be described by a single, effective absorption coefficient. The signal measured over a source, with both area and thickness effectively infinite in extent, is expressed as: $S_h = k(2\pi/\mu_E)s_0e^{-\mu_E h}$ where S_h is the signal intensity at altitude h above the source, s_0 is the theoretical signal at the surface of an elementary unit area of source material, μ_E is the effective absorption coefficient of its equilibrium flux in air, and k is a constant. In the interpretative technique, maximum values of signal intensity and flight altitude above ground are used to plot a lithological clearance-signal curve for each rock type in the survey area. Values of s_0 and μ_E which are characteristic of the rock may be determined from these curves. Accordingly the automatic correction of data for flight altitude, based on the assumption of a single absorption coefficient, is not valid for comparative aeroradiometry. The lithological clearance-signal data suggest that spectral analysis of γ radiation may provide useful data for a more detailed geological interpretation than the present technique permits. (auth)

HEALTH AND SAFETY

7638 (CF-59-5-131) REPORT OF FIRE IN LABORATORY HOOD, WING I, BUILDING 4500, MAY 22, 1959. T. W. Hungerford and J. E. Lain (Oak Ridge National Lab., Tenn.). July 30, 1959. 14p.

Approximately 16 to 18 liters of isopropyl alcohol in a 20-liter glass carboy in a floor type hood were ignited by infrared heat lamps used to heat the carboy and contents. A technician received several minor lacerations on the hand. (C.H.)

7639 (CF-61-1-33) DETERMINATION OF THE S. S. N. M. CONTENT OF THE SHIPMENT TO THE DAVISON CHEMICAL COMPANY, ERWIN, TENNESSEE, DECEMBER 20, 1960. G. S. Sadowski (Oak Ridge National Lab., Tenn.). Jan. 11, 1961. 12p.

A carrier containing 138.89 liters of solution, uranium concentration 202.04 g/liter with an isotopic concentration of 97.3% U^{233}, was prepared for shipment. The total uranium was 28,062 ± 60 g (95% confidence level) and the U^{233} 27,305 ± 66 g (95% confidence level). Testing and calibration of the carrier showed that its capacity to overflow was 173 liters, the upper liquid level probe was covered at 153 liters, and 15 to 200 ml of solution remained in the carrier after it was vacuumed empty through the solution withdrawal pipe. Sparging for adequate mixing required 90 min at 4 psig and 0.8 scfm of air. (auth)

7640 (KAPL-M-HP-6) HEALTH PHYSICS AND SAFETY QUARTERLY REPORT, JULY–SEPTEMBER 1960. R. J. Feinberg, comp. (Knolls Atomic Power Lab., Schenectady, N. Y.). 26p. Contract W-31-109-Eng-52.

No personnel radiation exposures were revealed which were greater than the maximum permissible limit. A summary is given of the radiation monitoring services provided during the report period. Radioactivity levels in environmental samples revealed no adverse effects caused by laboratory operations. Approximately 31 mc of fission product radioactivity, including < 0.1 mc of I^{131}, were discharged from the exhaust stack system. Liquid waste discharged to the Mohawk River included 300 mc of fission-product radioactivity. (B.O.G.)

7641 (NP-9768) FURTHER EVALUATION OF TISSUE DEPTH DOSES IN PROTON RADIATION FIELDS IN SPACE. Research Report No. 17. Hermann J. Schaefer (Naval School of Aviation Medicine, Pensacola, Fla.). May 24, 1960. 17p. Project MR005.13-1002.

Strong additional proton fluxes are superimposed upon the ordinary cosmic-ray beam at certain times and in certain regions in space. Four basic types of such transitory radiation fields are selected and the intratarget dosage distribution for a tissue sphere of 75 kg is evaluated. The large heterogeneity of the four spectra reflects in highly structured depth dose patterns that differ greatly and show a strong dependence on prefiltration. Present classifications in dosimetry with regard to penetrating power and total-body radiation burden for different radiations seem inadequate for proton beams in space. Additional provisions appear mandatory, particularly for the region of low penetrating power, in view of the high radiosensitivity of the lens of the eye. (auth)

7642 (TID-3552(Rev.)) SHIPPING, HANDLING AND STORAGE OF RADIOACTIVE MATERIALS. A Literature Search. Theodore F. Davis, comp. (Office of Technical Information Extension, AEC). Jan. 1961. 46p.

Included are 393 references to report literature, engineering drawings, and articles appearing in scientific journals. The majority of the references were taken from Nuclear Science Abstracts. The period from 1950 to 1960 is covered. (auth)

7643 (TID-11266) HIGH-ALTITUDE SAMPLING TECHNIQUES. Final Report for February 1, 1957 to July 31, 1959. Henry Halle (Chicago. Univ. Labs. for Applied Science). Oct. 1960. 32p. Contract AT(21-1)-508 (LAS-TR-M124-8). OTS.

A balloon-borne air collector unit was developed and operated to collect samples of stratospheric air for radiation analysis. A 19-lb air sample was obtained by liquefying the air at altitudes of 50,000 and 60,000 ft in a liquid-nitrogen-cooled heat exchanger. The construction and operation of the air-collector unit and the performance of five stratospheric balloon flights are presented. Equipment designed to recover stratospheric moisture and carbon dioxide from an air sample is described. (auth)

7644 ENVIRONMENTAL HAZARDS ASSOCIATED WITH THE MILLING OF URANIUM ORE. W. B. Harris, A. J. Breslin, H. Glauberman, and M. S. Weinstein. A. M. A. Arch. Ind. Health 20, 365-82(1959) Nov.

Hazards associated with mining and milling of uranium ore are examined. Hazards to plant workers are evaluated and a determination of environmental contamination which may result from these operations is made. The efficacy of control measures is also evaluated. Personnel hazards which are directly associated with the processes are emphasized, while large environmental contamination is of secondary importance in the study. (J.R.D.)

7645 THE RADIATION HAZARD. Transcription of a Panel Meeting. J. E. Rall (National Inst. of Arthritis and Metabolic Diseases, Bethesda, Md.). Bull. N. Y. Acad. Med. 36, 804-25(1960) Dec.

Hazards to human populations from natural and artificial radiations are discussed. Hazards from diagnostic x rays and from fall-out due to weapons testing are discussed in detail. (C.H.)

7646 PLANNING AN ENVIRONMENTAL SURVEY FOR A NUCLEAR POWER PLANT SITE. Peter J. Barry

Atomic Energy of Canada Ltd., Chalk River, Ont.). J. Air Pollution Control Assoc. 11, 14-18; 48(1961) Jan.

Some of the more important factors to be considered in planning an environmental survey are described, e.g., the potential of the environment for absorbing foreign matter; the presence of plant, animal, and human populations; and the nature of transport and dispersion mechanisms. As an example, the organization, procedures, and results of the survey made in locating the NPD-2 reactor are presented. (D.E.B.)

7647 RADIATION HAZARD IN INDUSTRY. R. R. Newell (Naval Radiological Defense Lab., San Francisco). J. Am. Med. Assoc. 175, 227-9(1961) Jan. 21.

The maximum permissible dose is not a measure of radiation injury or a health rule, but an operating rule. The observance of this rule reasonably well assures satisfactory protection for the health of those exposed and a negligible augmentation of genetic mutations. For widespread radiation hazard (contamination of environment), it is more efficient to attend to the pertinent measure, namely the over-all population average. Keeping the average below the level of significant augmentation of the mutation rate assures at the same time a negligible frequency of exposures productive of somatic injury. (auth)

7648 GEOMETRIC MEAN PARTICLE SIZE AND ITS APPLICATION IN THE SAMPLING OF AIRBORNE DUST. S. Guruswamy and V. S. Narasimhachar. J. Sci. Ind. Research (India). 18B, 319-23(1959) Aug.

To compare sets of experimental data on the distribution of different sizes of particles in studies on the sampling of airborne dust, it is necessary to choose suitable parameters of particle sizes. The method of calculating the geometric mean size from the experimental data is given, and the application of geometric particle size in dust sampling work is illustrated. The results analyzed show the different applications of the geometric mean particle size to practical dust sampling work. The geometric mean size is useful in the following cases; study of the performance of one sampling apparatus under different conditions, in the detailed study of a dust deposit from one sampling apparatus, comparison of the performance of two sampling apparatuses under a given set of conditions, and in the study of the variation of dust dispersion in one locality. (APCA Abstr. 6, 3238.)

7649 EXPONENTIAL MODEL OF BIOLOGICAL EXCRETION OF RADIOISOTOPES AND ITS APPLICATION FOR THE CALCULATION OF ABSORBED RADIATION DOSE. F. Vítek and Z. Dienstbier. Jaderná energie 11, 383-5(1960). (In Czech)

A formula model for the determination of absorbed radiation dose of incorporated radioisotope was derived. The model corresponds better to physiological assumptions than the older Stewarts' model and was verified experimentally by means of P^{32}. (auth)

7650 RADIATION SAFETY AND CONTROL—IV. NECESSARY RECORDS AND CHECKS. A. R. Gould (Royal Military College of Science, Swindon, England). Nuclear Energy 518-19, 541(1960) Nov.

The discussion of the duties and responsibilities of health-physics officers is extended to the determination of ingested activity from open sources and similar biological and clinical examinations of blood, breath, skin, and eyes, following exposures to radiation. Health physicists should keep a "Radiation and Health Register" in which is recorded all health-physics recommendations and the actions taken. The regular maintenance of many graphical representations of analyses of health-physics determinations is an essential aid to a comprehensive assessment of the over-all picture of radiation hazards. Without involving any costly or time-consuming techniques, very simple, regular checks for contamination will give confidence to the operators and minimize the possibility of wide-spread contamination. (B.O.G.)

7651 A PROTECTIVE SAFE FOR THE STORAGE OF RADIOACTIVE PREPARATIONS. A. A. Stankevich (Kirov State Inst. and Inst. of Oncology, Academy of Medical Sciences, U.S.S.R.). Problems Oncol. (U.S.S.R.) (English Translation) 6, 560-2(1960).

7652 SURVIVAL IN A NUCLEAR ATTACK, PLAN FOR PROTECTION FROM RADIOACTIVE FALLOUT; Report to Gov. Nelson A. Rockefeller. Albany, N. Y., Committee on Fallout Protection, 1960. 66p.

The need for protection of the population against the dangers of fall-out in the event of nuclear war is discussed and recommendations are made. The radiation protection program is centered in the home, and supplemented with reasonable protection at places of business and industry, schools, and other publicly-owned buildings. Legislation required for early action is outlined and shelter designs, criteria, and cost factors are discussed. Survival supplies, equipment, and food are listed and emergency water supplies are discussed. (C.H.)

7653 NUCLEAR SAFETY. Technical Progress Review, Vol. 2, No. 1. W. B. Cottrell, ed. (Oak Ridge National Lab., Tenn. 1960. 119p. $0.55(GPO) (Domestic), $0.70(GPO) (Foreign).

Coverage of the review is limited to topics relevant to the analysis and control of hazards associated with nuclear reactors, operations involving fissionable materials, and the products of nuclear fission. Primary emphasis is on safety in reactor design, construction, and operation; however, safety considerations in reactor fuel fabrication, spent-fuel processing, nuclear waste disposal, and related operations are also treated. Reviews of current literature, special review articles on specific topics, and comparative studies of various aspects of U.S. power reactors are included. (W.L.H.)

7654 IMPROVEMENTS IN OR RELATING TO CONTAINERS FOR STORING FISSILE MATERIAL. Ronald Turnstall Ackroyd and Dennis Kenyon (to United Kingdom Atomic Energy Authority). British Patent 855,420. Nov. 30, 1960.

A container for safely storing solutions containing a fissile mass greater than the minimum critical mass is designed, comprising a cellular structure of neutron-moderating and -absorbing material, e.g., a mixture of rare earths, encased in polyethylene and inserted in a vessel. The structure may either be in the form of a hexagonal cell lattice mounted vertically on a grid on the floor of the vessel or short tubes packed randomly in the vessel. (D.L.C.)

INDUSTRIAL APPLICATIONS OF ISOTOPES AND RADIATIONS

7655 (TID-6613) RADIOISOTOPES IN WORLD INDUSTRY. Abstracts of Selected Foreign Literature. (Office of Isotopes Development, AEC). Jan. 1961. 144p.

Abstracts are presented of 658 articles and publications, which were published during 1959 and 1960 in languages other than English, covering applications of radioisotopes by world-wide science and industry. The abstracts are grouped by subject and subgrouped by country to facilitate reference. Author and country indexes are appended, as is an index correlating the abstract numbers assigned in this bibliography with the numbers assigned sequentially by the Library of Congress. (C.H.)

7656 (TID-11586) INVESTIGATION OF THE EFFECTS OF IONIZING RADIATION ON THE SEDIMENTATION OF SEWAGE. First Quarterly Report. (Universal Match Corp., Ferguson, Mo.). Nov. 1, 1960. 56p. Contract AT(11-1)-905.

Activities in a program to investigate the effects of ionizing radiation on sedimentation of natural and synthetic sewage are summarized. A general research design was formulated and initial feasibility experiments were conducted on discrete chemical compounds using Co^{60} and x-ray sources. A comprehensive survey of the literature was conducted which included the present methods of sewage treatment, radiation chemistry and dosimetry, and methods of measuring sedimentation. The survey indicated an increasing need for sewage processing and the need for more efficient methods. Radiation effects on colloidal materials may increase the efficiency of sewage sedimenta tion, permitting a fuller utilization of existing facilities in many locations. Ionizing radiation may also be beneficial in controlling the number of pathogenic organisms in sewage and in degrading complex materials to more efficiently oxidized compounds. Methods of measuring sedimentation, such as cumulative sedimentation, optical density, and light scattering, were investigated. Optical density measurements of the entire sedimentation tube, either by uniform scanning or by readings at standard increments of the height, provide the most practical approach under the conditions in this laboratory. Representative suspensions of discrete compounds, e.g., bentonite, egg albumin, starch, and detergent compounds found in sewage are subjected to ionizing radiation at various absorbed dosages. The dose rate was either 97.8 or 38.5 R/min in all experiments. The results of these experiments indicated that at these low dose rates no significant sedimentation effects were obtained with the starch, albumin, and detergent preparations at maximum absorbed doses of 1.635×10^5 rads; however, a chemical change was suggested. The results indicated that the radiation effect on the settling of the bentonite suspension increased with increased absorbed doses within the limits of these experiments. Various designs for a large irradiation facility and a high dose rate in the order of 1000 R/min (air) irradiation field were investigated. Subsequent to these investigations, a single source of Co^{60} at one of the AEC facilities became available and a facility based on this source was designed. Radiation effects and dosimetry problems were discussed. After considerable investigation, polyvinyl chloride film was selected for purposes of dosimetry. (auth)

7657 (WASH-1030) MARKETING FEASIBILITY STUDY OF RADIATION PROCESSED FISHERY PRODUCTS. (Fish and Wildlife Service. Bureau of Commercial Fisheries, Washington, D. C.). Dec. 1, 1960. 36p.

Results are summarized from a marketing feasibility study of radiation processed fishery products. The purpose of this study was to determine, from various segments of the fishing and allied industries, the acceptability and the marketing feasibility of radiation processed fishery products. The basic procedures employed in this study consisted of personal and informal discussion of the subject matter with various segments of the industry. Special attempts were made to present an accurate description of the current status of the process in order to obtain realistic and unbiased opinions. (auth)

7658 RADIOISOTOPES AND THEIR APPLICATIONS. Bull. Inform. A.T.E.N., No. 26, 21-3(1960) Sept.-Oct. (In French)

The different technical areas where radioisotopes are used are pointed out. The French regulations governing use of radioisotopes are given. New uses of radioisotopes are given. (T.R.H.)

7659 PACKAGE IRRADIATION PLANT IN U. K. F. J. Ley (Wantage Radiation Lab., Berks, Eng.). Food Irradiation 1, No. 2, A6-A9(1960) Oct.-Dec.

Design features are described for a package irradiation plant for food irradiation. (C.H.)

7660 INFORMATION TO BE SUPPLIED IN SUPPORT OF A REQUEST FOR AUTHORISATION TO POSSESS RADIOACTIVE SUBSTANCES WITH A VIEW TO THE TREATMENT OF FOODSTUFFS BY IONISING RADIATIONS, FRANCE. Food Irradiation 1, No. 2, A10-A19 (1960) Oct.-Dec.

Information is outlined which is required in France in support of a request for authorization to obtain radiation sources for use in the processing of foodstuffs. (C.H.)

7661 TREATMENT OF MEATS WITH IONISING RADIATIONS. IV. COMPARISON OF THE DETERIORATION IN QUALITY DURING STORAGE OF EVISCERATED CHICKEN CARCASSES TREATED WITH CHLORTETRACYCLINE OR RADIATION. B. Coleby, M. Ingram, H. J. Shepherd, and M. J. Thornley (Low Temperature Research Station, Cambridge, Eng.). J. Sci. Food Agr. 11, 678-84 (1960) Nov.

Eviscerated chicken carcasses were treated with chlortetracycline (CTC) or irradiated with 0.3 or 0.6 Mrad and then stored at 0°C. Changes in quality during storage up to 26 days were studied, and microbial counts made on the carcasses. A dose of 0.6 Mrad caused a fairly rapid decline in quality; but with 0.3 Mrad or CTC, deterioration of quality was only noticed when the carcasses had been stored at 0°C for 19 days or longer. This loss of quality was not due to the growth of microorganisms. (auth)

7662 SAMARIUM 145, SAMARIUM 153, GADOLINIUM 153 AND THULIUM 170 SOURCES FOR RADIOGRAPHY. Farno L. Green, Willard D. Cheek, Robert E. Black, and Gene P. Graham (General Motors Corp., Warren, Mich.). Nondestructive Testing 18, 382-8; 402(1960) Nov.-Dec.

New radioactive sources of low-energy photons that can extend isotopic radiography to lower thickness-density ranges were fabricated and evaluated. Sm^{145}, Sm^{153}, and Gd^{153} sources are described and related to Tm^{170}. Applications of these sources to industrial and aircraft problems are illustrated. (auth)

7663 PROGRESS IN TECHNOLOGY. 4. APPLIED IRRADIATION. S. Jefferson (Wantage Radiation Lab., Berks, Eng.). Nuclear Power 6, No. 57, 80-1(1961) Jan.

The two large γ-radiation plants, the Package Irradiation Plant, and the Goat Hair Plant (Australia) are described. The potentialities of irradiation for sterilization of medical equipment and food and for graft polymerization are discussed in the light of current progress. (D.L.C.)

ISOTOPE SEPARATION

7664 PRODUCTION AND APPLICATION OF HEAVY WATER. L. Küchler (Farbwerke Hoechst AG, Frankfurt am Main). Chem.-Ingr.-Tech., 32, 773-81(1960) Dec. (In German)

Salt fusions can be employed in nuclear technology as solvent or extraction media in the preparation of special atomic fuels, as moderator and solvent for the fission products of homogeneous power reactors, and as a high-temperature coolant for nuclear reactors. The present state of development in this field and some chemical problems arising therefrom are discussed. (auth)

7665 THERMAL DIFFUSION FACTOR FOR HYDROGEN AND WATER MIXTURES. S. C. Saxena (Atomic Energy Establishment, Trombay, India). Indian J. Phys. 34, 449-55(1960) Oct.

The thermal diffusion factor for the system hydrogen and water vapor, was calculated from an equation which utilizes only the experimental data on transport properties and their temperature derivatives and is independent of any particular form for the intermolecular potential. The thermal diffusion factor was computed for other systems that emerge from the different isotopic species of these two principal components. The values are of particular interest in interpreting data obtained on the enrichment of hydrogen isotopes in a thermal diffusion column, using the chemical exchange reaction: $HD + H_2O \rightleftharpoons HDO + H_2$. (auth)

7666 ISOTOPIC SEPARATION OF INERT GASES IN ELECTROMAGNETIC ISOTOPE SEPARATOR. G. A. Koval'skiĭ and A. M. Rodin. Pribory i Tekh. Ekspt. No. 6. 84-9(1960) Nov.-Dec. (In Russian)

The accumulation of gaseous elements in an electromagnetic separator during isotope separation may be achieved by implanting ions in a metallic target or by pumping from a hermetically sealed receptacle. The first method has a high enrichment coefficient but a comparatively low efficiency, whereas the second offers high efficiency with a smaller coefficient of enrichment. It is suggested that the first method be utilized for less available isotopes and the second for more abundant isotopes. (tr-auth)

7667 SEPARATION OF BORON ISOTOPES BY THE METHOD OF CHEMICAL EXCHANGE. II. COMPLEX COMPOUND OF BORON TRIFLUORIDE WITH β,β'-DICHLORODIETHYL ETHER (CHLOREX). G. M. Panchenkov, A. V. Makarov, and L. I. Pechalin (Moscow State Univ.). Zhur. Fiz. Khim. 34, 2489-94(1960) Nov. (In Russian)

A new improved design of a countercurrent packed column was described. It was shown that in the isotopic exchange between BF_3 and the complex, $BF_3 \cdot (C_2H_4Cl)_2O$, separation of the boron isotopes takes place; the value of α lies within the limits of 1.01 to 1.02 (for 60°) with B^{10} concentrating in the liquid phase. It was observed that with rise in column temperature of 20 to 60° the separation factor increases. A description was given of the mass spectrometric analysis of BF_3. (auth)

MATHEMATICS AND COMPUTERS

7668 (AEEW-R-49) APPLICATION OF AUTOMATIC CHANGE OF INTERVAL TO DE VOGELAERE'S METHOD OF THE SOLUTION OF THE DIFFERENTIAL EQUATION $Y'' = f(x,y)$. M. H. Rogers (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Establishment, Winfrith, Dorset, England). Nov. 1960. 9p.

An extension is given to de Vogelaere's method for the solution of systems of second order differential equations from which first derivatives are absent. The extension is a description of the way in which automatic change in step-length can be made to give a prescribed accuracy at each step. (auth)

7669 (CF-59-10-59) A SPECTROGRAPHIC INTENSITY-RATIO ANALOG COMPUTOR. R. E. Weekley (Oak Ridge National Lab., Tenn.). Oct. 14, 1959. 5p.

An analog computer was designed and constructed, using commercially available hardware, for use in photoelectronic spectrographic analysis. This instrument is quite sensitive, nearly drift-free, and records either absolute spectral line intensities or the ratio of any two spectral line intensities on either integrated or a real time basis. (auth)

7670 (IMM-NYU-266) A UNIFIED THEORY OF ESTIMATION. I. (Revised and Extended, February 1960). Allan Birnbaum (New York Univ., New York. Inst. of Mathematical Sciences). Apr. 1960. 81p. Contract Nonr-285(38).

Previous formulations and theories of estimation for one-parameter problems are extended and unified. The basic criterion used is admissibility of a point estimator, defined with reference to its full distribution rather than special loss functions such as squared error. Theoretical methods of characterizing admissible estimators are given, and practical computational methods for their use are illustrated in a variety of examples. Point, confidence limit, and confidence interval estimation are included in a single theoretical formulation and incorporated into estimators of an "omnibus" form called "confidence curves." The usefulness of the latter for some applications as well as theoretical purposes is illustrated. Fisher's maximum likelihood principle of estimation is generalized, given exact (nonasymptotic) justification, and unified with the theory of tests and confidence regions of Neyman and Pearson. Relations between exact and asymptotic results are discussed. An application of the general theory gives optimal sequential estimators having prescribed precision in a specified interval. (auth)

7671 (NP-9764) ESTIMATION OF SAMPLE SIZE. AFOSR Report No. 28. N. L. Johnson (Case Inst. of Tech., Cleveland). Nov. 1960. 17p. Contract AF49(638)-361.

The problem considered is that of estimating the total number of individuals in a sample, given a number of the observations in the sample ranked either from the greatest or the least. Attention is directed especially to the case when the r smallest values in the sample are known; and the population distribution of the observed character is also known. It is shown that in this case the largest of the observations (i.e. the r-th smallest in the complete sample) is a sufficient statistic for the sample size. This is also true if the r-th smallest and any subset of the (r-1) smaller observations are available. Methods of estimation by discriminant analysis, maximum likelihood, and confidence intervals are discussed. To attain a specified accuracy in distinguishing between two sample sizes n_0, n_1, where $n_1/n_0 = k$, it is found that the required value of r approaches a finite limit (depending on k and the required accuracy) as n_0, n_1 approach infinity. (auth)

7672 (SCTM-88-59(14)) ON THE PROBABILITY THAT A CUMULATIVE SUM OF SEQUENTIAL SAMPLES

EXCEEDS A GIVEN THRESHOLD. F. H. Jean (Sandia Corp., Albuquerque, N. Mex.). Oct. 28, 1959. 16p. OTS.

When a regularly increasing number of pulses (or samples) occurring at regular intervals are summed, it is difficult to evaluate the probability that the sum will exceed a given threshold for the first time at some specific instant or at a specific number of samples. The purpose of this work is to give bounds, and proof of the bounds, that are more readily calculated than the precise probabilities. (auth)

7673 (TID-11370) PROGRESS REPORT ON COMPUTER RESEARCH AND DEVELOPMENT. (Chicago. Univ. Inst. for Computer Research). [nd]. 9p. Contract AT(11-1)-614.

Progress is reported in the design and construction of processor, memory, input-output, and control units for computers. (W.L.H.)

7674 (UCRL-5859) TABLES OF SOLUTIONS OF LEGENDRE'S EQUATION FOR INDICES OF NONINTEGRAL ORDER. David J. BenDaniel and William E. Carr (California. Univ., Livermore. Lawrence Radiation Lab.). Sept. 1960. 68p. Contract W-7405-eng-48.

A report containing a tabulation of the functions $F_n^S(x)$ and $F_n^A(x)$ to five places for values of x from 0.00 to 0.99 in steps of 0.01 and for values of n in steps of 0.0625 from 0 to 1.0000, of 0.1250 from 1.0000 to 10.0000, and of 0.2500 from 10.0000 to 36.0000 is presented. A tabulation of the zeros, α_i, of the functions $F_n^S(x)$ and $F_n^A(x)$ to four places from x = 0.00 to x = 0.99 and a tabulation of the integrals, $\int_0^{\alpha_i} F_n(x)\,dx$, of the functions $F_n^S(x)$ and $F_n^A(x)$ to four places from x = 0.00 to each of the zeros of those functions are included along with a tabulation of the integrals of the functions $[F_n^S(x)]^2$ and $[F_n^A(x)]^2$, $\int_0^{\alpha_i} F^2(x)\,dx$ to four places, from x = 0.00 to each of the zeros of those functions. (auth)

7675 (AEC-tr-4400) SOME DISTRIBUTIONS OF ERRORS OF MEASUREMENT. Bohumel Pardubský. Translated from Československ. časopis pro fysiku 5, 521-30 (1955). 13p. JCL.

Distributions of measurement errors are presented on the assumption that the systematic error or precision of measurement is a function of time. The method makes possible the determination of the reliability interval for the correct value in such cases. (auth)

7676 A NOTE ON EVALUATING DETERMINANTS. Frank Harary and Ralph E. Williamson (Los Alamos Scientific Laboratory). Am. Math. Monthly 67, 660(1960) Aug.–Sept.

Methods for evaluation of determinants are discussed and a comparison of the method of contractants with the well-known very natural triangular method is examined. The formulas of arithmetic operations for the method of contractants and the corresponding formulas for straightforward application of the triangular method are tabulated. (J.R.D.)

7677 IMPROVEMENTS IN OR RELATING TO SLIDE-RULES OR CALCULATORS. Robert Selwyn Morgan (to Minister of Aviation). British Patent 859,063. Jan. 18, 1961.

A slide rule is designed for the rapid solution of a number of calculations associated with protection from γ radiation, especially the calculation of shielding thickness required for a certain dose rate at a distance from the γ source. The mathematical basis of the slide rule is given. Two forms of the slide rule, straight and circular, are illustrated. (D.L.C.)

7678 ELECTRONIC MULTIPLIER. D. M. Collier, L. A. Meeks, and J. P. Palmer (to U. S. Atomic Energy Commission). U. S. Patent 2,969,915. Jan. 31, 1961.

An electronic multiplier is described for use in analog computers. Two electrical input signals are received; one controls the slope of a saw-tooth voltage wave while the other controls the time duration of the wave. A condenser and diode clamps are provided to sustain the crest voltage reached by the wave, and for storing that voltage to provide an output signal which is a steady d-c voltage.

METALS, CERAMICS, AND OTHER MATERIALS

General and Miscellaneous

7679 (BM-RI-5696) EVALUATING ONE-HALF MILLION POUNDS OF ZIRCONIUM SPONGE. M. D. Carver and H. Kato (Bureau of Mines, Washington, D. C.). Apr. 1960. 16p.

A description of a quality evaluation procedure for certifying the adequacy of Kroll process zirconium sponge for reactor applications is presented. Included are descriptions of sponge blending, types of sponge, sampling for analysis, and ingot evaluation procedure. The procedure was used to control the quality of ½ million pounds of zirconium sponge comprising 259 production lots. (J.R.D.)

7680 (BMI-1488) PROGRESS ON THE DEVELOPMENT OF URANIUM CARBIDE-TYPE FUELS. Phase II Report on the AEC Fuel-Cycle Program. Frank A. Rough and Walston Chubb, eds. (Battelle Memorial Inst., Columbus, Ohio). Dec. 27, 1960. 64p. Contract W-7405-eng-92.

Investigations in the field of chemical synthesis have demonstrated the feasibility of preparing uranium monocarbide from uranium metal by reaction with methane. The product obtained is suitable for direct compaction and sintering into pellets. Powder metallurgical techniques were developed for cold-pressing and sintering uranium carbide powders containing excess uranium metal to densities above 90% of theoretical. Hot pressing was employed to consolidate uranium carbide powders to densities of essentially 100% of theoretical. The skull arc-melting and casting process for uranium carbide was developed to where it is possible to make a single casting weighing up to 5 kg or several smaller castings having the same total weight. The strength and hardness of uranium carbides are relatively insensitive to composition in the range from 4.8 to 9.0 wt. % carbon. The 7.0 wt. % carbon alloy is slightly harder than the other alloys in the as-cast condition. When heat treated to produce the U_2C_3 structure, the 7.0 wt. % carbon alloy has a hardness of about 1100 KHN as compared to about 700 and 500 KHN for UC and UC_2, respectively. The strength and integrity of uranium carbides are very adversely affected by exposure to moisture. Alloying with refractory carbides alleviates this problem. Alloys of uranium monocarbide with Mo_2C, NbC, VC, and ZrC show high strength and hardness plus improved resistance to corrosion in Santowax R at 350°C, and constitute a new and highly promising class of carbide fuel materials. Uranium monocarbide is compatible with aluminum and magnesium up to about 600°C, with mild steel and copper up to about 900°C, with stainless steel, Inconel, and zirconium to

near or slightly below 800°C, and with niobium, molybdenum, and tantalum to about 1200°C, depending upon the exact conditions. The activation energy for self-diffusion of uranium in uranium monocarbide is 82 kcal/mole or essentially the same as the activation energy for interdiffusion of uranium and carbon (79 kcal/mole). The rate of interdiffusion is over 500 times faster than the rate of self-diffusion of uranium. Irradiations of uranium monocarbide to burn-ups of 0.01 and 0.03 at. % of the uranium have produced data that suggest that elastic expansion of the lattice reaches its limit between these two exposures, and that the additional stress applied to the lattice by exposures to burn-ups of 0.03 at. % and greater is relieved by reduction of the crystallite size. (auth)

7681 (KAPL-M-LEM-1) RECLAMATION AND EVALUATION OF ZIRCALOY-2 SCRAP. L. E. McGinnis (Knolls Atomic Power Lab., Schenectady, N. Y.). Sept. 22, 1960. 16p. Contract W-31-109-Eng-52. OTS.

A program was undertaken to determine the feasibility of reprocessing Zircaloy-2 scrap (cleaning, pickling, and chopping) of quality sufficient to permit its use as a substitute for sponge, chop stock for fuel melting, or as starting material for the manufacture of powder. Scrap reprocessing and evaluation of the resulting melt stock are emphasized. Discolorations due to shear burn and an abnormally high titanium and uranium content are investigated. (auth)

7682 (NP-9751) FINAL REPORT FOR PERIOD OCTOBER 1, 1959 THROUGH OCTOBER 31, 1960. (Texas Instruments, Inc., Dallas). Dec. 4, 1960. 13p. Contract Nonr 3006(00).

Studies were made to develop a method for preparing graded band-gap alloys of the GaAs–P system, produce ingots with band-gap gradation, and determine thermoelectric parameters of the material to optimize the figure of merit. Small graded band-gap ingots (30 g) were successfully prepared by modified zone melting in sealed quartz tubes. These ingots ranged in composition from $GaAs_{.5}P_{.5}$ to GaAs. Measurements of resistivity and Seebeck emf at room temperature and as a function of temperature are reported for these small ingots. (auth)

7683 (TID-11580) CRYSTALLITE SIZE AND PARTICLE SIZE MEASUREMENTS ON BeO POWDERS BY X-RAY METHODS. S. F. Bartram (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Aug. 11, 1960. 32p.

Presented at the Ninth Annual Conference on Applications of X-ray Analysis, Denver Research Inst., Univ. of Denver, Denver, Colorado.

As part of a study on the fundamental properties of BeO, the surface area, particle size, and crystallite size of BeO powders prepared from different source materials were measured. The results obtained by means of small-angle x-ray scattering and x-ray line-broadening were compared with electron micrographs and surface area values by air permeability, nitrogen adsorption, and water-vapor adsorption. Small-angle scattering data were analyzed to yield particle-size distribution curves as well as surface areas for various calcined BeO samples. Line-broadening measurements were made to determine mean crystallite dimensions of the same materials. Using both photographic film and automatic recording techniques, crystallite sizes from about 50 to over 5000 A were estimated. The rate of growth of BeO crystals from beryllium hydroxide, beryllium sulfate, and beryllium oxalate source materials was followed by these complementary techniques. (auth)

7684 (USBM-U-761) QUARTERLY METALLURGICAL PROGRESS REPORT NO. 8 FOR THE PERIOD OF JULY 1, 1960 TO SEPTEMBER 30, 1960. (Bureau of Mines. Albany Metallurgy Research Center, Ore.). 24p. Contract AT(11-1)-599.

Filtration of molten $ThCl_4$ through molybdenum wool followed by a porous Inconel disk will remove up to 94% of the ThO_2 suspended in the melt. Step-wise reduction of UF_6 by either sodium or magnesium was developed. A nozzle for injecting UF_6 into molten sodium was designed and fabricated. Zirconium was separated from hafnium by techniques based on fractional crystallization of their fluoride salts leached from roasted zircon sand and selective reduction and disproportionation of their chloride salts. The phase diagram of the Hf–Ta system was explored further by metallographic techniques. The establishment of the Fe–Gd phase diagram is nearly complete. The Ni–Gd equilibrium diagram indicates a system with three eutectic points which occur at 10 to 15, 70 to 75, and 90 to 95% gadolinium. Preliminary investigation indicates a 15 at. % solubility of iridium in titanium at 1400 and 1600°C. Iridium-rich alloys appear to be compatible with molybdenum up to 1850°C. The use of finned air-cooled copper crucibles to replace conventional water-cooled crucibles was explored by melting a series of 10 iron ingots. Several hundred grams of hafnium carbide crystals were prepared in an arc furnace. (For preceding period see USBM-U-745.) (W.L.H.)

7685 (NP-tr-541) THE INFLUENCE OF THE NUMBER OF IMPACTS IN PULVERISATION. Y. Nakagawa and K. Matsui. Translated by S. G. Brickley (U.K.A.E.A. Atomic Energy Research Establishment) from Kagaku Kogaku 21, 810-16(1957). 15p.

Crushing was accomplished by dropping a steel ball on a plunger resting on cubic or powdery samples (stoneware) in a steel mortar. The relation between passthrough of the crushed products and number of blows is shown. Equations are given which show the relation between net work input to crushing and number of blows. (W.L.H.)

7686 (UCRL-Trans-625) STUDY OF THE PREPARATION OF JUNCTIONS n-p BY DIFFUSION OF BORON AND PHOSPHORUS IN SILICON. Georges Feuillade. Translated by D. A. Nimidoff from J. chim. phys. 56, 593-608(1959). 46p.

A study was made of boron and phosphorus diffusion in silicon, from which the theory and practice can be of benefit. The study neglects the influences of the diffusion process, which would manifest itself in volume and not strictly in surface, and the mutual entrainment of the diffusing species. Thus the problem is reduced to the determination of the superficial concentration of impurity and its variation with time. The results are given which indicate synthetically the domains of an optimum production and theoretically the complex physiocochemical schemes to which the interfacial reactions obey. Considerations are given of the results endeavoring to illustrate common characteristics susceptible to a generalization of a scheme that can be of use generally, as well as in particular applications, in chemical and physical studies. (B.O.G.)

7687 THE RELATIONSHIP OF THERMAL AND MECHANICAL PROPERTIES IN HIGH TEMPERATURE CARBURIZED CARBON POLYMERS. V. K. Zamoluev, L. N. Mukhanova, and E. M. Talts (Inst. of Natural Fuels, Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R., 133, 1143-5(1960) Aug. 11. (In Russian)

Natural carbonaceous materials such as Donets anthracite, gas black, and lignite were pyrolized at a temperature of 750 to 2350°C, and observations were made on the changes in the specific heat capacity Cp, temperature conductivity, heat conductivity, microhardness, resistance to fracture, and the distance between the carbon atom planes. It was determined that an increase in the interplanar distance is the basic reason for a linear decrease in the specific heat capacity of the graphitized material. There was a sharp increase in the microhardness, heat conductivity, and temperature conductivity on heating from 750 to 1100°C. On increasing the temperature there was a destruction of carbon side chains with an increase in degree of order in the lattice. There was an increase in the interplanar distance, a decrease in specific heat capacity and a substantial increase in temperature conductivity and heat conductivity. At higher temperatures the material acquired the ability to deform plastically, and hence, its resistance to fracture rose. Thus, the thermal stability of a carbon can be improved by carrying out the thermal decomposition at a stage where the temperature conductivity, heat conductivity, and plasticity are all high. (TTT)

7688 DEVELOPMENT OF MATERIALS FOR THERMIONIC GENERATORS. John Coltman (Westinghouse Electric Corp.). Nuclear Energy 530-2(1960) Nov.

The thermionic generator is a concept which promises to open up new areas in power generation at high-operating temperatures. Although still in early stages of development, thermionic generators offer promise in applications where compactness, lightness in weight, simplicity, and high efficiency are required. The materials used in these generators must have a high heat of vaporization combined with a low work function (the potential difference between the interior and exterior of the solid material), and must be capable of operation at temperatures to ~4500°F for long periods of time. Several materials for which the efficiency has been calculated are: lanthanum boride, mixed carbides, thoriated tungsten, tantalum carbide, and tungsten. Nuclear sources lend themselves to thermionic converters because they can provide temperatures limited only by the structural properties of the materials used. It is pointed out that there has been no particular urge to find or produce materials having the peculiar properties demanded by the thermionic converter. (B.O.G.)

7689 PRODUCTION OF IMPERMEABLE GRAPHITE. Nuclear Power 6, No. 57, 97-8(1961) Jan.

A pilot plant for production of impermeable graphite by impregnation with furfuryl alcohol and carbonization was constructed. It consisted of two furnaces: one for carbonization at 1000°C and another for graphitization at 3000°C. Details of the furnace design are given. Provision is made for fine control of the heating elements. Illustrations of the plant and a table of the properties of untreated and treated graphite are included. (D.L.C.)

7690 ALKALINE EARTH ELEMENTS (BARIUM, CALCIUM, AND STRONTIUM). (Office of Technical Services, Washington, D. C.). July 1960. 21p. (SB-422). $0.10(OTS).

A bibliography of 335 reports listed in the two OTS monthly abstract journals: U. S. Government Research Reports and Technical Translations. Reports listed cover the metals and compounds of barium, calcium, and strontium, as well as research on their toxicity, hazards, and safety in handling. These reports were added to the OTS collection during the period 1950 to August 1960.

7691 ALKALI METALS: LITHIUM, SODIUM, POTASSIUM, RUBIDIUM, AND CESIUM. (Office of Technical Services, Washington, D. C.). July 1960. 37p. (SB-421). $0.10(OTS).

A bibliography of 672 reports listed in the two OTS monthly abstract journals: U. S. Government Research Reports and Technical Translations. Reports listed cover the metals, alloys, and compounds of lithium, sodium, potassium, rubidium, and cesium, as well as research on their toxicity, hazards, and safety in handling. These reports were added to the OTS collection during the period 1950 to July 1960.

7692 MOLTEN AND FUSED SALTS. (Office of Technical Services, Washington, D. C.). Aug. 1960. 9p. (SB-425). $0.10(OTS).

A bibliography of 135 reports are listed in the two OTS monthly abstract journals: U. S. Government Research Reports and Technical Translations. This bibliography includes reports added to the OTS collection during the period 1950 to September 1960.

7693 LIQUID METALS. (Office of Technical Services, Washington, D. C.). Aug. 1960. 10p. (SB-424). $0.10(OTS).

A bibliography of 179 reports listed in the two OTS monthly abstract journals: U. S. Government Research Reports and Technical Translations. This bibliography includes reports added to the OTS collection during the period 1950 to September 1960.

7694 IMPROVEMENTS RELATING TO METHODS OF AND APPARATUS FOR SPRAYING METALS OR OTHER SOLID MATERIALS. William Edward Ballard and Peter Best (to United Kingdom Atomic Energy Authority). British Patent 851,594. Oct. 19, 1960.

A method of spraying metals or other solid materials such as metal oxides and silicates is described. It has none of the drawbacks of previous spraying methods. The method consists in mixing the powdered solid material with a binder, extruding a pasty rod from the mixture, and feeding the rod to a spray-producing station where it is subjected to gaseous propellant and heating means. The binder may be sugar solution, glycerine, methyl cellulose, starch, or a thermoplastic material. A spraying apparatus for putting this method into effect is described. (D.L.C.)

7695 IMPROVEMENTS IN OR RELATING TO HIGH TEMPERATURE ELECTROLYTIC CELLS. (to Commissariat à l'Energie Atomique). British Patent 857,602. Jan. 4, 1961.

An electrolytic cell for preparing pure metals by electrolysis of molten salts under vacuum is designed capable of operation at high temperatures, e.g., 1000 to 1200°C, of a vacuum of 10^{-4} to 10^{-5} mm Hg with relatively small pumping, and of facile cleaning in case of salt sublimation or crucible breakage. The cell is constructed entirely out of metal except for the crucible and comprises an externally heated muffle, a crucible forming one electrode of the cell, and a cooling chamber isolated from the muffle by two sealing valves. The second electrode extends through the cooling chamber so that it can be lifted from the crucible into the cooling chamber; in this way, the electrodeposited metal can be removed from the muffle and cooled, and a second cooling chamber brought into position for another operation. With this cell, it is possible to prepare zirconium containing 0.004% oxygen. (D.L.C.)

7696 IMPROVED PROCESS FOR THE PRODUCTION OF GRAPHITE. (to Pechiney Compagnie de Produits Chimiques et Electrometallurgiques). British Patent 858,667. Jan. 11, 1961.

A process for production of graphite in which graphitization and purification are effected simultaneously is out-

lined. A fluorine-containing compound is used to produce a purifying vapor which impregnates the material in the graphitization furnace. In this way, it is possible to produce reactor-grade graphite from coke, even in the presence of a heat-insulating layer containing impurities such as SiO_2 and SiC. Possible variants of this process are discussed and illustrated with 3 examples. (D.L.C.)

7697 SINTERING METAL OXIDES. W. E. Roake (to U. S. Atomic Energy Commission). U. S. Patent 2,952,535. Sept. 13, 1960.

A process is given for producing uranium dioxide material of great density by preparing a compacted mixture of uranium dioxide and from 1 to 3 wt. % of calcium hydride, heating the mixture to at least 675°C for decomposition of the hydride and then for sintering, preferably in a vacuum, at from 1550 to 2000°C. Calcium metal is formed, some uranium is reduced by the calcium to the metal and a product of high density is obtained.

7698 METHOD OF PREPARING URANIUM, THORIUM, OR PLUTONIUM OXIDES IN LIQUID BISMUTH. J. K. Davidson, W. L. Robb, and O. N. Salmon (to U. S. Atomic Energy Commission). U. S. Patent 2,961,390. Nov. 22, 1960.

A method is given for forming compositions, as well as the compositions themselves, employing uranium hydride in a liquid bismuth composition to increase the solubility of uranium, plutonium and thorium oxides in the liquid bismuth. The finely divided oxide of uranium, plutonium, or thorium is mixed with the liquid bismuth and uranium hydride, the hydride being present in an amount equal to about 3 at. %, heated to about 500°C, agitated and thereafter cooled and excess resultant hydrogen removed therefrom.

7699 HIGH TEMPERATURE MICROSCOPE AND FURNACE. D. M. Olson (to U. S. Atomic Energy Commission). U. S. Patent 2,969,712. Jan. 31, 1961.

A high-temperature microscope is offered. It has a reflecting optic situated above a molten specimen in a furnace and reflecting the image of the same downward through an inert optic member in the floor of the furnace, a plurality of spaced reflecting plane mirrors defining a reflecting path around the furnace, a standard microscope supported in the path of and forming the end terminus of the light path.

Corrosion

7700 (ARF-2198-10) IMPROVED ZIRCONIUM ALLOYS. Monthly Report No. 9 [for] Period Covered December 1–December 31, 1960. D. Weinstein and F. C. Holtz (Illinois Inst. of Tech., Chicago. Armour Research Foundation). Jan. 5, 1961. 8p. Project Agreement No. 1. Contract AT(11-1)-578.

Activities in a program to develop zirconium alloys with superior corrosion resistance to water and steam at 680 to 900°F are summarized. (J.R.D.)

7701 (CF-53-12-42) THE RADIATION INDUCED CORROSION OF BERYLLIUM OXIDE IN SODIUM AT 1500°F. W. E. Brundage and W. W. Parkinson (Oak Ridge National Lab., Tenn.). Dec. 3, 1953. Decl. Dec. 6, 1959. 9p. OTS.

Beryllium oxide specimens of various densities, immersed in sodium, were irradiated in the LITR for 328 hr at 1500°F plus 110 hr at 750°. The exposure at the higher temperature was about 1.8×10^{19} thermal nvt and 0.9×10^{19} fast. Control specimens were subjected to the same heat treatment in sodium and the average weight loss was found to be 0.0007 g (0.037%) with no significant difference between the irradiated and control groups. The surface-to-volume ratio was roughly 2.5 cm^2/cm^3. (auth)

7702 (CF-56-8-85) THE HIGH-TEMPERATURE CORROSION RESISTANCE OF HASTELLOY "B" AND MOLYBDENUM TO RUBIDIUM. R. Carlander (Oak Ridge National Lab., Tenn.). Aug. 14, 1956. Decl. Apr. 28, 1960. 7p. OTS.

Rubidium standpipe and seesaw corrosion tests in Hastelloy "B" and in molybdenum capsules, which were performed for 500 hr at various temperatures, produced no mass transfer and little attack of the two materials. The depth of attack (½ to 2 mils) was approximately the same in the bath, boiling, and vapor zones of the Hastelloy "B" test capsules. Intergranular penetration was found in the bath and boiling zones but not in the vapor zones of the Hastelloy "B" standpipe tests. The attack (1 mil) in the Hastelloy "B" seesaw test was in the form of subsurface voids. No attack occurred in the molybdenum seesaw test, but recrystallization occurred on the outside diameter of the hot zone. (auth)

7703 (CF-61-1-21) SUMMARY OF RUNS 1, 2, AND 3 IN HIGH-TEMPERATURE, HIGH-PRESSURE TITANIUM LOOP. J. C. Griess, J. M. Baker, and H. C. Savage (Oak Ridge National Lab., Tenn.). Jan. 6, 1961. 7p. OTS.

Simulated-reactor-fuel solutions were circulated at temperatures as high as 365°C in a small titanium pump loop. A hydroclone separator separated heavy phases formed at high temperatures. As the temperature of the solution was increased beyond the two-liquid-phase temperature (327°C), the salt concentration of the light phase decreased and the acid concentration increased. The mole ratios of uranium to sulfate, uranium to copper, and uranium to nickel in the light phase decreased in the same proportion in the temperature range of 330 to 365°C. Corrosion of titanium and Zircaloy-2 specimens was insignificant during the relatively short exposure periods. (auth)

7704 (IDO-14516) CORROSION OF ALLOYS IN AQUEOUS HYDROFLUORIC–NITRIC ACID SOLUTIONS. J. J. Bordeaux and G. S. Adams (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). July 27, 1960. 12p. Contract AT(10-1)-205.

Materials for the construction of dissolvers, columns, evaporators, and piping were evaluated in boiling mixtures of hydrofluoric-nitric acids for three 48-hr periods. Included in the tests were Carpenter-20, Hastelloy F, Incoloy 804, Monel, tantalum, types 309, and 316 extra-low-carbon-content stainless steel. The data indicated that none of the materials tested was suitable on a long-term basis for process equipment at the acid concentrations studied. (auth)

7705 (KAPL-M-BSS-1) THE EFFECT OF HEAT TREATMENT ON THE CORROSION BEHAVIOR AND MECHANICAL PROPERTIES OF ZIRCALOY-2. B. S. Shabel (Knolls Atomic Power Lab., Schenectady, N. Y.). Sept. 15, 1960. 32p. Contract W-31-109-Eng-52.

A literature survey was made to correlate the effect of heat treatment and microstructure on the corrosion and mechanical properties of Zircaloy-2. Slow cooling (<90°F min) from the β or α plus β regions results in a coarsened microstructure with coarse-grain boundary precipitates. This structure is associated with initially poorer corrosion resistance than the finer grained structure containing less precipitate that results from rapid cooling. The mechanical strength of Zr-2 is not greatly affected by either annealing temperature or cooling rate,

but the ductility is lowered from 40 to 60% by β-annealing regardless of cooling rate. The ductility remains lowered up to test temperatures of 600°F. (auth)

7706 (KAPL-M-HOS-11) THE EFFECT OF THE PRESENCE OF UNTEMPERED MARTENSITE ON STRESS CORROSION PROPERTIES OF AISI 410. Henry Suss (Knolls Atomic Power Lab., Schenectady, N. Y.). Dec. 7, 1960. 25p.

AISI 410 specimens tempered over 1125°F for 4 hr minimum, supposedly immune to stress corrosion cracking, showed anomalous stress corrosion results after 1 week exposure in 300°F air saturated water with applied stress of 60,000 psi. The unexpected stress corrosion failures were attributed to an improper heat treating practice. The specimens were not fully cooled, from the austenitizing temperature, to below M_f before tempering, thus retaining untransformed austenite. The retained austenite converted to untempered martensite on cooling from the tempering temperature. The studies revealed that initiation and propagation of the stress corrosion cracks were promoted by and directly proportional to the amount of untempered martensite present. Proper heat-treat procedures (cooling from austenizing temperature to room temperature to allow complete conversion of austenite to untempered martensite prior to exposure for 4 hr minimum to tempering temperatures in excess of 1125°F) will make the alloy immune to stress corrosion failures. At present, metallographic studies are the best and only available method to inspect for proper (absence of untempered martensite) heat treating practices. A second temper at 1125°F or higher (double tempering) will convert any untempered martensite to tempered martensite. This double tempering procedure will have to be evaluated to determine that metallurgical changes, especially the bands of isothermal transformation products formed in the prior austenite grain boundary, do not have any significant effects on the mechanical and corrosion properties. (auth)

7707 (TID-11396) EFFECTS OF TURCO (4501A, 4502, 4518) DECONTAMINATING REAGENTS ON STAINLESS STEEL BEARING MATERIALS; EXPERIMENTAL GAS COOLED REACTOR. B. H. Flippen (Allis-Chalmers Mfg. Co. Atomic Energy Div., Washington, D. C.). Oct. 10, 1960. 18p. Contract AT(10-1)-925. (RD-0203). OTS.

Tests were made to determine the etching effect of decontaminating reagents on AISI 440C bearing materials specified for the construction of the EGCR service machine. The decontamination chemicals discolored and etched the 440C stainless-steel specimens. Approximately 1.5 to 2.5 mils were removed from specimens subjected to 6 complete decontamination cycles. (W.L.H.)

7708 NICKEL–ALUMINUM COATINGS PROTECT METALS UP TO 1830°F. Materials in Design Eng. 52, 10-11(1960) Nov.

A method was developed for producing an aluminum-nickel coating for the protection of metals to 1830°F. The coatings have proven effective on steel, nickel, and molybdenum, and will probably be applicable to other metals. In air at 1020 and 1830°F the coatings (backed with steel) oxidized at one-tenth the rate of nickel coatings of comparable thickness. Because of their high oxidation resistance the coatings are expected to be useful for many aerospace uses. (B.O.G.)

7709 DEVELOPMENTAL V-Cb ALLOYS HAVE EXCELLENT CORROSION RESISTANCE. S. T. Wlodek (Union Carbide Metals Co.). Materials in Design Eng. 52, 14-15(1960) Nov.

An investigation was initiated to determine whether niobium additions to a vanadium matrix would increase the usefulness of vanadium as an engineering material. A Stern-Bishop diagram is given which shows the high resistance of 50 : 50 Nb–V to oxidizing and reducing atmospheres. Graphical representations are given for the oxidation resistance of three vanadium-base alloys compared with pure vanadium in air at 1290°F and the strength-to-weight ratio of 60V–40Nb and 49V–40Nb–10Ti–1Si compared to the strongest iron-, titanium-, and molybdenum-base alloys. Tensile tests show that niobium additions to vanadium act as solid solution strengtheners as would be expected from the high solubility and maximum amount of lattice strain caused by the difference in atomic radii. This condition can be improved by titanium additions but strength is sacrificed. (B.O.G.)

7710 HIGH TEMPERATURE OXIDATION OF ZIRCONIUM AND ITS ALLOYS IN WATER–VAPOR. Tatsuo Maekawa and Junjiro Kai. Nippon Kinzoku Gakkaishi 24, 581-4(1960). (In Japanese)

Rates of of oxidation and hydrogen absorption of iodide-processed high-purity zirconium, commercial-grade zirconium, Kroll-processed reactor-grade zirconium, its 2.5% tin alloy, and 0.24% iron alloy with water vapor were measured at 650 to 850°C. The results were: (1) There was no great difference between the oxidation rates in water vapor and in oxygen. (2) The percentage of absorbed hydrogen in the specimens oxidized with water vapor were 1 to 20% of hydrogen produced by the oxidation process and decreased as the temperature became higher. (3) The amounts of absorbed hydrogen were larger in the specimens of higher oxidation rate than in those of lower oxidation rate. (auth)

7711 ON THE OXIDATION MECHANISM OF Zr-Te ALLOYS (STUDIES ON THE OXIDATION OF ZIRCONIUM AND ITS ALLOYS, 2nd REPORT). Tadao Sano, Shosuke Imoto, and Mungyu Kang. Nippon Kinzoku Gakkaishi 24, 604-7(1960). (In Japanese)

The beneficial effect of tellurium as an additive on the oxidation resistance of zirconium has been reported. It was stated that the addition of tellurium would decrease the concentration and the mobility of oxygen ion vacancies. Experiments by oxidation test were carried out to determine whether the vacancy concentration or the mobility is mainly affected by the presence of tellurium in the oxide. The results obtained were: tellurium addition was not so effectual at high temperatures as at low temperatures, but the amount of tellurium addition which resulted in the longest breakaway time (i.e., the lowest oxidation amount) was scarcely changed by the oxidation temperature and nitrogen content which was said to increase the concentration of oxygen ion vacancy. From these results it was concluded that a tellurium ion in zirconium oxide does not contribute to the decrease in the vacancy concentration, but mainly to the decrease in the mobility of vacancy by taking the state of positive quadrivalency. (auth)

7712 HIGH TEMPERATURE OXIDATION OF ZIRCONIUM AND ITS ALLOYS IN CARBON DIOXIDE. Tatsuo Maekawa. Nippon Kinzoku Gakkaishi 24, 608-11(1960). (In Japanese)

The oxidation rate of reactor-grade zirconium and its 2.5% tin alloy and 0.24% iron alloy in carbon dioxide was measured at 650 to 850°C, and 15 to 760 mm Hg, using the weight-gain method. The results were compared with the oxidation data in oxygen, and are expressed as follows: (1) No great difference was found on the initial stage of the oxidation between the oxidation rates in carbon dioxide and

in oxygen except 2.5% tin alloys. (2) In the post-breakaway period, the rate constants depended on the change of gas pressure, and the oxidation rates in carbon dioxide were lower than the oxidation rates in oxygen, and remarkably lower in 2.5% tin alloys. (3) No existence of carbon absorption was found during the oxidation of specimens in carbon dioxide by chemical analysis. It was concluded that the reaction proceeds in accordance with the equation of $Zr + 2CO_2 = ZrO_2 + 2CO$, and the oxidation in carbon dioxide is similar to the oxidation in lower-pressure oxygen. (auth)

7713 STUDY OF THE PITTING CORROSION OF METALS BY MEANS OF MODELS. L. N. Tarasova, V. V. Romanov, and N. I. Kudinova. Zhur. Priklad. Khim. 33, 2285-90(1960) Oct. (In Russian)

A novel method was developed for investigating the effect of stress concentration on the electrode potentials of the cathodic and anodic regions of the galvanic cells formed during pitting by means of special models. The experimental assembly was constructed from small disks with and without a central hole. The disks with central holes were filled with a corroding NaCl solution. The aluminum disks used were subjected to varying amounts of stress as an experimental parameter. It was found that the current obtained depended on the relative size of the cathodic and anodic areas. The initial increase and subsequent decrease of the current is explained by the "healing" of the pits. Stressing influenced the current considerably because it contributed to the breakdown of the protective layer. Results confirm the electrochemical theory of the mechanism of pitting corrosion, based on the formation of local cells. (TTT)

7714 INVESTIGATION OF CRACK CORROSION OF THE 1Cr18Ni9 TYPE STEEL IN CHLORIDES IN THE PRESENCE OF ORGANIC INHIBITORS. N. I. Podobaev and S. A. Balezin. Zhur. Priklad. Khim. 33, 2290-2300(1960) Oct. (In Russian)

An attempt was made to uncover inhibitors that would protect stainless steel from corrosion cracking in chloride solutions and to study their effect on the electrode processes and on the rate of the corrosion. The 9.91% nickel–18.44% chromium stainless-steel specimens were kept under stress by a spring mechanism. A 42% $MgCl_2$ solution and a saturated solution of $CaCl_2$ were used as corroding media at 153°C. The surface-active agent katapin ($[CH_3(CH_2)_{10}CH_2\ (C_6H_4)\ CH_2\ (NC_5H_5)]Cl$) and the inhibitor I-1-A, obtained by distilling the oily layer formed during the synthesis of 2-methyl-ethyl pyridine, were tested along with other materials. Both of them slowed down the corrosion cracking caused by the $MgCl_2$ solution without stopping it completely. The katapin appears to act primarily by inhibiting the anode process. (TTT)

7715 PITTING CORROSION INHIBITOR. N. G. Chen (Dneprodzerzhinsk Evening Metallurgical Inst., [USSR]). Zhur. Priklad. Khim. 33, 2300-5(1960) Oct. (In Russian)

Localized corrosion, which is one of the most dangerous types of attack of corrosive media on metals, is usually observed when the solution contains hydrogen and chlorine ions with insufficient amounts of oxidizing agents to passivate the metal. Tests were made with solutions containing NaCl and neutral or acid sodium phosphates, sodium nitrate, bichromate, and sulfate. It was found that the inorganic passivating agents that allow the formation of a protective layer on the surface of the metal do not prevent the breakdown of this layer by chlorine ions, resulting in pitting attack. An inhibitor prepared during the coking process was found to eliminate pitting both at room temperature and at boiling although in the latter case the uniform attack was enhanced. (TTT)

7716 THE "CREVICE EFFECT" IN THE INHIBITING PROCESS OF ATMOSPHERIC CORROSION. A. V. Shreider and S. A. Gintsberg. Zhur. Priklad. Khim. 33, 2541-7 (1960) Nov. (In Russian)

The crack corrosion preventing action of various inhibitors during atmospheric attack, which is much less understood than similar processes in aqueous media, was investigated by exposing metal specimens, protected by wrapping with a paper saturated with inhibitor solutions, to attack by a corrosive atmosphere containing 0.1 mg/l of SO_2. During the tests the temperature was cycled from 20 to 40°C, while the humidity was kept between 94 and 96%. The effect of crevice formation was mocked-up by clamping together 0.1-mm-thick foils of the metal. The wrapping paper was saturated with an inhibitor, such as ammonium benzoate, dicyclohexyl ammonium chromate or nitrite, triethanolamine molybdate, or urotropin + $NaNO_2$. It was found that many inhibitors present a "crevice effect," resulting in the enhancement of the corrosive attack in the artificially imitated cracks and crevices because the inhibitors are not able to exert their action on the internal surfaces formed. Addition of surface-active agents, such as phenyl benzoate, phenyl oleate, or butyl benzoate to the volatile amines improved this situation. (TTT)

7717 INVESTIGATION OF THE HYDROGEN-CORROSION OF CARBON STEEL PIPES. Yu. I. Archakov (All-Union Scientific Research Inst. of Petrochemical Processes, [USSR]). Zhur. Priklad. Khim. 33, 2547-52 (1960) Nov. (In Russian)

In order to clarify the effect of various factors such as pressure, temperature, period of interaction, wall thickness, and pipe diameter on the depth of the decarburized zone formed when carbon steels are exposed to hydrogen, test specimens of different carbon steel pipes were filled with technical hydrogen gas and soaked at the desired temperature under the calculated internally applied pressure. The depth of the decarburized zone was determined by the microscopic examination of the etched metallurgical specimens. It was established that the decarburizing reaction rate constant is an exponential function of the temperature. The equations were derived for calculation of the depth of penetration of hydrogen on the 10-mm-thick pipes with 30 mm OD at various temperatures and pressures as a function of the soaking time. The pressure was varied from 50 to 800 kg/cm^2, the temperature from 400 to 630°C, and the soaking time from 36 to 625 hr. (TTT)

7718 OXIDATION RESISTANT CHROMIUM ALLOY. J. A. McGurty, J. F. Collins, and V. P. Culkins (to U. S. Atomic Energy Commission). U. S. Patent 2,955,937. Oct. 11, 1960.

A binary alloy of chromium and yttrium is given. It consists of from about 0.2 to about 2.5 wt.% yttrium, the balance being chromium.

Fabrication

7719 (DMIC-141) TITANIUM-ALLOY FORGINGS. H. J. Henning and P. D. Frost (Battelle Memorial Inst. Defense Metals Information Center, Columbus, Ohio). Dec. 19, 1960. 90p. Contract AF18(600)-1375. (PB-151100).

A summary of current information on the availability, metallurgical and dimensional quality, and mechanical properties of titanium alloy die forgings is presented. Detailed data on typical forgings are presented, and some forging techniques are discussed. (auth)

7720 (HW-66757) FABRICATION OF ALUMINUM CLAD PLUTONIUM–ALUMINUM ALLOY PIN ELEMENTS.

L. C. Lemon and W. T. Ross (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Sept. 1, 1960. 13p. Contract AT(45-1)-1350.

Specifications are given for the fabrication of Al–Pu alloy pins clad in aluminum. The cladding components were fabricated from 1100 aluminum, $\frac{1}{16}$ in. in diameter. End caps were fabricated from the same material by a series of passes through draw plates to 0.035-in. diameter. The core material was cast as cylinders 0.375 in. in diameter and approximately 2 in. long in a heated graphite mold. The alloy composition was 15.75 wt.% plutonium. Billets $\frac{1}{4}$ in. long were cut from the cylinders. These were extruded through an 87 to 1 reduction in area to a final size of 0.032 ± 0.001 in. For loading, the cans were inserted in a lucite fixture and placed in an open-front hood, the cores dropped in, and the can opening scrubbed with ethyl alcohol. The 0.035-in. diameter end cap wire was then pressed into the can opening until it contacted the core and was cut off level with the top of the can. Sealing of the final end was done by fusion welding using alternating current with the tungsten inert gas process. (W.L.H.)

7721 (KAPL-M-MJG-1) EVALUATION OF HAFNIUM FORMED BY HOT BENDING. M. J. Galvez (Knolls Atomic Power Lab., Schenectady, N. Y.). Dec. 9, 1960. 29p. Contract W-31-109-Eng-52.

A program was described to evaluate the corrosion resistance, relaxation bend angle and heat treatment of short lengths of reactor grade hafnium which had been hot formed on a hydraulic press. No serious surface imperfections were observed. The angle of bend in two samples which were autoclaved experienced relaxation. Results of tests indicated good corrosion resistance. Deformation twins formed during bending were almost eliminated by 1700°F heat treatment but it produced heterogeneous grain growth in the deformation area. Heat treatment at 1475°F for six hours resulted in a small reduction in deformation twins and no grain growth. (J.R.D.)

7722 (NAA-SR-Memo-5735) SOME ASPECTS OF VACUUM VERSUS AIR-MELTING OF HASTELLOY N. T. S. Jakubowski (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Sept. 28, 1960. 5p.

A program was conducted to investigate methods of melting Hastelloy N and their effects on the properties of the melt. It was found that the mechanical properties of these alloys are improved by careful vacuum melting, and it is recommended that components of SNAP reactors be fabricated from vacuum-melted heats. (J.R.D.)

7723 (NP-9784) PREPARATION AND PROPERTIES OF ULTRAFINE HIGH PURITY REFRACTORY METAL POWDERS. BiMonthly Progress Report No. 1, September 21, 1959 through November 30, 1959. E. S. Candidus (National Research Corp., Cambridge, Mass.). Jan. 14, 1960. 11p. Contract NOas 60-6003-C.

A program to produce ultrafine refractory metal powders, was undertaken in which the refractory metal will be heated and evaporated by electron bombardment. The evaporation was carried out in an inert gas environment at 10 to 50 μ pressure. The engineering approach to bringing the electron beam from an electron source in a high vacuum environment to the vicinity of the evaporating metal was discussed and progress in the construction of the necessary hardware was reported. (auth)

7724 (ORNL-2948) METALLURGY OF ZIRCALOY-2. PART II. THE EFFECTS OF FABRICATION VARIABLES ON THE PREFERRED ORIENTATION AND ANISOTROPY OF STRAIN BEHAVIOR. P. L. Rittenhouse and M. L. Picklesimer (Oak Ridge National Lab., Tenn.). Feb. 1, 1961. 219p. Contract W-7405-eng-26.

The preferred orientation and anisotropy of strain behavior of Zircaloy-2 were studied as functions of fabrication variables. An inverse-pole-figure technique was used for the preferred orientation determinations. Evaluation of the effects of the fabrication variables on the anisotropy of strain behavior was accomplished by a contractile strain-axial strain analysis. An analysis of strain behavior in the normal direction was developed on the basis of theory of plastic flow of anisotropic metals. A simple intuitively derivable relation was found to exist between the strain-strain analysis and the preferred orientation data. Correlations of the strain-strain data with true-stress-true-strain diagrams and mechanical properties were attempted. The preferred orientation of Zircaloy-2 produced by the Oak Ridge National Laboratory-Homogeneous Reactor Project (ORNL-HRP) metallurgy fabrication schedule (ingot breakdown at 1800 to 1900°F, major reduction at 1800 to 1900°F or 1350 to 1450°F, a heat treatment of 30 min at 1800 at 1850°F followed by a water quench or rapid air cool to below 1200°F, a final reduction of 25 to 40% at 1000°F, and a 30-min anneal at 1400 to 1425°F) was weak compared to that of most of the other schedules investigated. Elimination of the β heat treatment (1800 to 1850°F for 30 min) between the major reduction and final reduction steps resulted in a material with a high degree of preferred orientation and with a state of pseudoisotropy in the rolling plane. A unique and quite high degree of preferred orientation was developed when the ORNL-HRP metallurgy fabrication procedure was used, but the ingot axis was in the transverse rather than the rolling direction of the finished plate permitting more contractile strain to occur in the normal direction than in either the rolling or transverse directions. The strain-strain analyses of the materials were consistent with the conclusions reached by the preferred orientation analyses. The effects of cross rolling on the anisotropy of strain behavior of Zircaloy-2 were found to depend on the type of cross rolling (unidirectional or rotational), the temperature of cross rolling, and the stage of fabrication at which the cross rolling was done. Unidirectional cross rolling at 1000°F after β heat treatment caused only a slight increase in anisotropy of strain behavior over that for straight-rolled material, but rotational cross rolling at 1000°F after β heat treatment resulted in a material with a state of isotropy of strain behavior only in the rolling plane. Rotational cross rolling before β heat treatment, for one material at 1450°F and for another from 1900°F, produced different states or degrees of anisotropy of strain behavior. Because of flow constraints which exist in sheet-type tensile specimens with width-to-thickness ratios > 1.0, it is imperative that round tensile specimens be used in the contractile strain-axial strain analysis. Since the principal axes of anisotropy are generally not the major sheet directions, they must be found by the preferred orientation analysis. (auth)

7725 (ORNL-2995) A PRELIMINARY STUDY OF THE AGING BEHAVIOR OF WROUGHT COLUMBIUM–1% ZIRCONIUM ALLOYS. David O. Hobson (Oak Ridge National Lab., Tenn.). Jan. 27, 1961. 27p. Contract W-7405-eng-26.

The aging behavior of nine commercial heats of Nb–nominal 1-wt.%-Zr alloys was determined at 816°C and 927°C for periods up to 750 hr by tensile and hardness tests. Several of the alloys responded to heat treatment. The aging phenomena was found to be influenced by the pre-

ge annealing temperature as well as the impurity content f the alloys. Higher annealing temperatures led to more ronounced aging effects. The aging or nonaging behavior f the alloys was found to be correlated with their oxygen–itrogen ratios and to a lesser extent with their oxygen–arbon ratios. A positive correlation was found between he amount of oxygen added to the alloy and the tendency or aging to occur. When sufficient oxygen was added, the ging tendency could be virtually eliminated. No correla-on was found between observed aging effects and surface ontamination. (auth)

726 (SCNC-312) ISOSTATIC PRESSING OF UO_2 IN IIGH TEMPERATURE METALS. I. Sheinhartz and . Fugardi (Sylvania-Corning Nuclear Corp., Bayside, I. Y.). Sept. 1960. 14p. Contract AT-30-1-GEN-366.

The hot isostatic pressing process was applied at tem-eratures up to 1500°C for the fabrication of high-tempera-ure fuel rods composed of UO_2 clad in niobium and UO_2 in ron–aluminum type alloy. The fused UO_2 powder appar-ntly becomes quite plastic at temperatures above 1200°C nd can be isostatically compacted at 1500°C to 98% of its neoretical density. Niobium tubes particularly lend them-elves to the fabrication of fuel rods by simultaneously ompacting and cladding UO_2 powders in the tubes, but the ast iron–aluminum type alloy that was used was unsatis-actory because of its brittleness. (auth)

727 (TID-6286) FLAME-SPRAYED REFRACTORY COATING FOR HEATED GRAPHITE MOLDS. O. R. Mago-eaux, H. M. Eikenberry, D. L. Elston, and J. E. Blasdel [National Lead Co. of Ohio, Cincinnati]). [1959]. Decl. Apr. 5, 1960. 3p.

A pilot-scale evaluation was performed to determine if he life of induction-heated graphite molds used for casting ranium could be improved. Molds flame-sprayed with nagnesium zirconate ($MgZrO_3$) had approximately $2\frac{1}{2}$ imes the life of molds coated with standard magnesia vash. It was recommended that flame-sprayed magnesium irconate be used to coat heated molds in production oper-tions. A material and a method of repairing mold surface efects to further increase the life of heated molds were uccessful on one mold. (auth)

728 (TID-6287) EVALUATION OF REFRACTORY COATINGS FOR GRAPHITE CRUCIBLES AND MOLDS USED IN THE VACUUM MELTING OF URANIUM. O. R. Magoteaux, H. M. Eikenberry, and D. L. Elston (National Lead Co. of Ohio, Cincinnati). [nd]. Decl. Apr. 5, 1960. 5p. OTS.

Flame-sprayed magnesium zirconate was evaluated as a crucible coating and mold coating for the vacuum melt-ng and casting of uranium. The quality of the metal was affected by the use of this coating. Slug-to-good-slug ields were decreased when the coating was used on rucibles and were increased when the coating was used n molds. Carbon and hydrogen levels in ingots melted n magnesium zirconate-coated crucibles were decreased, ut not significantly. (auth)

729 (TID-11494) PREPARATION OF THORIA SOLS; PREPARATION OF THORIA MICRO-BEADS; INSTRUMENTATION FOR SLURRY SYSTEMS; EXTRAC-TION OF URANIUM FROM THORIA. Final Report [for] anuary 1956 to June 1958. H. A. Green and A. H. Weiss Houdry Process Corp. Research and Development Labs., inwood, Penna.). 61p. For [Oak Ridge National Lab., enn.]. Contract W-7405-eng-26, Subcontract 904.

The work completed on studies of thoria sols and lurries for nuclear reactors and on design and testing of instrumentation for the remote measurement of slurry properties at reactor operating conditions are summarized. The experimental program was concerned primarily with the preparation and testing of thoria sols and micro-beads intended for use in reactor blanket slurries. Also described are methods for recovering bred uranium thoria beads without damage to the bead structure. (auth)

7730 (WADD-TR-60-489) INVESTIGATION TO DEVELOP OPTIMUM PROPERTIES IN FORGED Ti–7Al–4Mo. Period covered: February 1958 to June 1960. James E. Hamer (Crucible Steel Co. of America. Midland Research Lab., Penna.). June 1960. 144p. Project No. 7351. Contract AF33(616)-6122.

The influence of six processing sequences on the microstructure, mechanical properties, and heat treatment response of the alloy Ti–7Al–4Mo was studied. Forging entirely above the β transus produced a Widmanstatten type of structure. The creep resistance of this structure was excellent; however, heat treatment response and tensile ductility were poor. Forging entirely below the β transus developed an equiaxed microstructure and generally good properties except for reduced creep resistance. Duplex forging, i.e., forging initially above the β transus, cooling to room temperature, and reheating to below the β transus for finish forging, produced a nearly equiaxed microstructure and general property levels quite similar to all below-β forging but with improved creep resistance. (auth)

7731 ON THE VIBRATIONAL INCREASE OF DENSITY IN POWDER METALLURGY. V. I. Likhtman, N. S. Gorbunov, I. G. Shatalova, and P. A. Rebinder (Inst. of Physical Chemistry, Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R. 134, 1150-2(1960) Oct. 11. (In Russian)

Vibration compression (14,000 vibrations/min, 0.03 mm amplitude) was used in extruding various titanium carbides and tungsten–cobalt powders. For WC-6 and WC-20 alloys with 6 and 20 wt. % cobalt, the vibrations reduced compression about 100 fold. For T15K6 (complex titanium-tungsten carbide) with 15% titanium and 6% cobalt, a maximum density of 7.8 g/cm^3 was obtained with vibro-pressure at p = 9kГ/cm^2, while the static compression required is p ≈ 1500 kГ/cm^2. A maximum density of 6.4 g/cm^3 was obtained for T30K4 containing the same carbide with 30 wt. % titanium and 4 wt. % cobalt at p = 12 kГ/cm^2. The static pressure required is p ≈ 1500 kГ/cm^2. (R.V.J.)

7732 AN UNUSUAL FEATURE OF THE FUSION WELDING OF NIOBIUM TO VANADIUM. R. D. Johnston and L. W. Derry (Battersea Coll. of Tech., London). Nature 189, 52-3(1961) Jan. 7.

Apex-shaped boundaries were seen between the fusion zone and parent plate during the fusion welding of niobium to vanadium. Studies at various currents and electrode rates indicate the boundary is formed by the dissolution of niobium in weld metal. (C.H.)

7733 HOW TEMPERATURE AFFECTS THE MEASUREMENT OF ALUMINUM. J. C. Moody (Sandia Corp., Albuquerque, N. Mex.). Tool Engr. 3-8(1960) Feb. (SCR-156)

Experiments to demonstrate the effects of temperature and transfer of heat on dimensional measurements of aluminum work pieces and to show the effects of thermal phenomena on production line procedures for aluminum materials are described. (J.R.D.)

7734 TIG WELDING JOINS SMALL STAINLESS TUBES TO THICK TUBE-SHEET. J. M. Gerken and D. B. Kittle (Knolls Atomic Power Lab., Schenectady, N. Y.). Welding J. (N.Y.) 45, No. 11, 46-8(1960) Nov.

A technique is described which can be used for internally butt welding stainless-steel tubing, as small as 0.240-in. ID by 0.035-in. wall thickness, successfully to thick tube-sheets. The conditions are tabulated for welding the tubes to the tube-sheets, and between tubes. The five welds joining 6- and 3-in. lengths of tubing had a good appearance, and all welds passed the dye-check and mass spectrometer leak tests. Radiographic examinations showed defect-free welds, while two tubes had good strength and ductility. In the simulated tube-sheet, 13 of the 14 welds passed the mass-spectrometer leak test. The failure appeared to have a leak in the tube-sheet extension rather than in the weld. Weld heat input, adequate for tube-to-tube-welding, was not great enough to make full penetration welds in tube to tube-sheets. Changing the position of the tungsten electrode, so that it strikes more directly on the heavier tube-sheet extension side of the joint, may give better control of weld drop-through. (B.O.G.)

7735 IMPROVEMENTS IN THE MANUFACTURE OF MICROPOROUS METALLIC TUBES CONSISTING MAINLY OF NICKEL. (to Commissariat à l'Énergie Atomique). British Patent 849,511. Sept. 28, 1960.

Microporous tubes of nickel or nickel oxide having very thin walls (~0.1 mm), small pore size (~0.01 μ), high permeability to gases, and good corrosive resistance to gases such as UF_6 may be produced according to this method: A powder of nickel or nickel oxide, preferably obtained by reducing nickel formate or oxalate, is crushed and coated with a binder volatile at 200 to 400°C, preferably gum tragacanth, in an amount ranging from 2 to 10 wt.%, and the resulting paste is repeatedly extruded through nozzles to form vermicular threads. The paste is then extruded in the form of tubes which are dehydrated, dried, and then sintered at 500 to 900°C in hydrogen, inert gas, or vacuum. Examples of this method are given in which nickel tubes of 15-mm diameter and 0.2-mm thickness are produced and their pore sizes and permeabilities measured. (D.L.C.)

7736 METHOD FOR JOINING ALUMINIUM TO STAINLESS STEEL. (to U. S. Atomic Energy Commission). British Patent 856,221. Dec. 14, 1960.

A method for soldering aluminum to stainless steel is outlined which has no need for a flux, scraping the aluminum surface to keep it clean, or electroplating, and which results in a gas-tight, noncorrosive, non-distorted, and high-strength bond. The method comprises abrading and cleaning the workpieces, tinning a portion of the aluminum piece at 650°F with a solder that alloys with aluminum and lead-tin solder, tinning a portion of the stainless steel piece at 450°F with a lead-tin solder, and contacting the two pieces at the tinned portions at 500 to 600°F. The solder for tinning aluminum may consist mainly of tin with minor amounts (~1% each) of silver and lead. Some possible applications of this method are discussed. (D.L.C.)

7737 IMPROVEMENTS IN OR RELATING TO MATERIALS FOR SHIELDING AGAINST NUCLEAR AND ALLIED RADIATION. Andrew Bandi Futo and Frank Allsop (to Unibrix Radiation Shieldings Ltd.). British Patent 856,747. Dec. 21, 1960.

Portable shielding blocks of high density for permanent or temporary shielding walls can be manufactured by mixing 80 to 95 wt.% dense material (e.g., barytes) with 5 to 15 wt.% cement as binder, 0 to 5 wt.% of a material (e.g., pectates), and 3 to 6 wt.% water and compressing the mixture at ≥1000 psi to give blocks with a density of ≥150 lb/cu ft. The blocks are shaped so that when assembled into a shielding wall, no straight joints exist, eliminating possible radiation leakage. Examples of this method of manufacture are given in which barite and iron shot are used as the dense material, and drawings are included illustrating the possible block shapes. (D.L.C.)

7738 IMPROVEMENTS IN OR RELATING TO METAL CASTING. Henry Lloyd and Michael Lesney Noakes (to United Kingdom Atomic Energy Authority). British Patent 856,785. Dec. 21, 1960.

A method for casting metals, especially uranium, in vacuum with a finer grain and minimum pipe and porosity faults is outlined in which the mold is vibrated with a frequency of 50 to 1000 cps during pouring and solidification. An example of this method is given in which 7.4-kg uranium samples were poured into stationary and vibrating (amplitude = 0.04 in.) molds; the primary pipe faults were found to extend to 1 to 2 in. of the bar from the pouring end in the vibrated mold as compared to 10 in. in the stationary mold. (D.L.C.)

7739 IMPROVEMENTS IN OR RELATING TO NUCLEAR REACTORS. George Erasmus Darwin and Norman George Worley (to Babcock and Wilcox Ltd.). British Patent 857,009. Dec. 29, 1960.

Uranium fuel rods or plates for use in gas-cooled, graphite-moderated reactors may be fabricated with improved strength properties over elements clad with aluminum by cladding with a uranium alloy. Suitable uranium alloys contain 7 to 15 wt.% molybdenum, 6 to 10 wt.% niobium, up to 30 wt.% zirconium, up to 4.8 wt.% carbon, and ternary alloys such as U–Nb–Zr and U–Nb–Mo. The coatings can be applied by bonding with heat. The coating thickness for reactor use should be $\geq 1/16$ in. (D.L.C.)

7740 IMPROVEMENTS IN OR RELATING TO PROCESSES FOR PRODUCTION OF LOW PERMEABILITY CARBON. Donald Arthur Boyland and John William Brightwell (to General Electric Co., Ltd.). British Patent 857,157. Dec. 29, 1960.

Carbon of low permeability may be prepared from permeable carbon in the following manner: The pores of the carbon sample are either evacuated or filled with water vapor and the sample is immersed in molten sugar or a warm concentrated solution of sugar of density ≥1.4 g/cc under pressure to force the sugar into the pores. The sample is then drained, cooled, and placed in a pressure vessel or bomb where it is heated to 250°C under a pressure great enough to prevent the water vapor formed by the sugar decomposition from forcing the formed carbon out of the pores. Greater reduction of permeability may be obtained by carrying out the decomposition process with the sample immersed in water. The sample is then heated slowly to 1000°C or more to expel the remaining volatile decomposition products. The advantages of this method are that short times are required, the impregnation can be repeated, and the mechanical strength of the carbon is enhanced with successive impregnation treatments. With this method, the permeability of grade A graphite was reduced by a factor of 50 in a single impregnating process and by a factor of 1000 in 2 or 3 impregnating processes. (D.L.C.)

7741 METHOD OF PREPARING A FUEL ELEMENT FOR A NUCLEAR REACTOR. (to United States Atomic Energy Commission). British Patent 857,672. Jan. 4, 1961.

An economical method for fabricating UO_2–ThO_2 ceramic fuel elements consists of mixing finely divided U_3O_8 or UO_2 with ThO_2, pressing the mixture to form a body of the desired size and shape, and firing the body in air at a tem-

erature between 1450°C and the fusion point of the mixture. this high temperature, U_3O_8 and/or UO_3 decomposes to O_2, and the internal stresses resulting from the shrinkage voids are relieved without cracking. A number of such odies were prepared and examined; those containing up to wt.% U_3O_8 were free of visible defects, whereas those ntaining 30 to 70 wt% UO_2 were somewhat cracked but emed satisfactory for reactor use. Irradiation tests were rried out on similar bodies containing 2.5 and 10% UO_2 in actor neutron fluxes of 2×10^{13} to 4×10^{14} neutrons/cm^2/ c and in pressurized water and NaK environments; after tensive irradiation, the bodies were found intact, although few had fragmented and others contained microscopic acks. Fuel elements containing 6.6 wt.% U_3O_8 enriched % in U^{235} were prepared in the above manner and are now ed in the Borax IV reactor. (D.L.C.)

7742 IMPROVEMENTS IN OR RELATING TO MAGNESIUM BASE ALLOYS CONTAINING MANGANESE. erek James Whitehead and Eric Arthur Walker (to agnesium Elektron Ltd.). British Patent 858,200. an. 11, 1961.

A magnesium–manganese alloy treatment is described hich results in wrought products with large resistance grain growth on subsequent annealing or operation at gh temperatures. The treatment consists of a solution eat treatment of the cast billet for 2 to 6 hr at 550 to 30°C prior to extrusion or other plastic deformation at 75 to 350°C to form the products. This treatment may e used with alloys containing 0.3 to 2.5% manganese, and her metals which improve the alloy properties may be dded, e.g., up to 0.2 wt. % zirconium, which refines the rain, or cerium, which improves the creep resistance. n example of this treatment is given in which one of vo billets of an alloy containing 0.77% manganese was olution heat treated and then cooled slowly while the her billet was not. After extrusion into bars, the average rain size was determined to be 0.40 and 3.9 mm for the ars from the treated and untreated billets, respectively. D.L.C.)

7743 IMPROVEMENTS RELATING TO VESSELS ONTAINING FLUID UNDER PRESSURE. Raymond Wallis akin and Samuel Sidney Gill (to AEI-John Thompson Nulear Energy Co. Ltd.). British Patent 858,221. Jan. 11, 961.

An arrangement of a pressure vessel with pipes passing bliquely through the wall is described which facilitates oining the pipes to the wall by welding. This arrangement ntails bosses passing through the wall at the desired laces with pipes attached to the boss ends. The bosses are apered at the ends contacting the wall and the edge of the lliptical apertures of the wall receiving the bosses are hamfered to conform to the surfaces of the bosses. This rrangement is of particular use in reactor pressure essels with standpipes running through their spherical nds. (D.L.C.)

7744 IMPROVEMENTS IN OR RELATING TO METHODS OF MANUFACTURING PROTECTIVE CANS FOR NUCLEAR REACTOR FUEL ELEMENTS. Eric William Vickers Acton and Michael Carl Hartnell-Beavis (to General Electric Co., Ltd.). British Patent 858,294. Jan. 11, 1961.

Finned tubes with a combination of inclined (helical) nd longitudinal fins may be fabricated from tubes having ntegral fins, e.g., finned tubes formed by extrusion; thus, hermal barriers resulting from joining fins to tubes which nay impair the heat-transfer efficiency are avoided. The abrication is performed on tubes with integral fins either of the longitudinal or helical (the inclination being the same for all fins) variety in this manner: a series of transverse cuts is made in the shorter fins at equal intervals along the tube length, and each fin segment thus formed is twisted at the top so that its tip is inclined or longitudinal to the tube, depending on whether the fins were originally longitudinal or inclined. Thus, an integral finned tube may be made which has improved heat transfer and reduced tendency to bow under reactor irradiation and thus is particularly suitable for containing reactor fuel elements. (D.L.C.)

7745 THIS INVENTION RELATES TO THE APPLICATION OF METALLIC COATINGS TO CHROMIUM PLATED URANIUM SURFACES. (to United Kingdom Atomic Energy Authority). British Patent 858,301. Jan. 11, 1961.

A method of applying an adherent metal coating to chromium-plated uranium is described in which the plated uranium is dipped into molten aluminum or aluminum alloys, with or without flux. This method can be used to produce final protective coatings for uranium or bonding means to unite the chromium surface to other metals. Possible variants of the method are illustrated by examples in which chromium-plated uranium, with or without copper or nickel coatings interposed between the chromium and the uranium, is dipped in Zn–1% Al, Al–12% Si, Zn–5% Al, and Al molten baths. (D.L.C.)

7746 TREATMENT OF URANIUM. Bernard Nelson Watts and Maurice Arthur Cayless (to British Thomson-Houston Co., Ltd.). British Patent 858,656. Jan. 11, 1961.

A method is given for forming a UO coating which protects uranium against tarnishing in air and against reaction with metals at 400 to 600°C. In a vacuum or inert gas the coating is formed on uranium either by preoxidizing and then heating to decompose the higher oxides to the monoxide or by heating to 500 to 600°C in an atmosphere of pure water vapor at very low pressure, e.g., 10 mm to 1 μ Hg. Three examples of this method are given. (D.L.C.)

7747 FORMING PROTECTIVE FILMS ON METALS. (to United States Atomic Energy Commission). British Patent 859,122. Jan. 18, 1961.

A method is outlined for providing films on ferrous metals which are resistant to attack by corrosive liquid metals at high temperatures. This method consists of selecting a ferrous metal having a nitrogen content of $\geq$0.003% and contacting its surface with a liquid metal which has dissolved therein $\geq$0.5 ppm zirconium, titanium, or hafnium so that a protective nitride layer forms on the surface. Other nitriding metals which form nitrides less stable than those of zirconium, titanium, and hafnium may be used. Continuous protection may be obtained by using a ferrous metal with a high nitrogen content throughout its mass and dissolving $\geq$0.5 ppm zirconium in the liquid metal in which the ferrous metal is to be immersed. Examples of the method are given, one of which illustrates the inertness of ZrN–ZrC to liquid bismuth and lead–bismuth alloys. (D.L.C.)

7748 IMPROVEMENTS RELATING TO THE CANNING OF FUEL ELEMENTS FOR USE IN NUCLEAR REACTORS. Bernard Nelson Watts and Derek Shaw (to British Thomson-Houston Co., Ltd.). British Patent 859,206. Jan. 18, 1961.

A method is given for coating fissionable fuel with niobium films preparatory to cladding with an aluminum can to prevent reaction between fuel and can. Such films are at least 50% niobium and 0.1 to 0.2 μ thick and may be pre-

pared by evaporation onto the fuel elements in a chamber in which a niobium piece is attached to a tantalum heater. (D.L.C.)

7749 CLADDING URANIUM WITH ALUMINUM. Samuel Storchheim (to Sylvania-Corning Nuclear Corp.). British Patent 859,503. Jan. 25, 1961.

An improved process for cladding uranium with aluminum is outlined in which a thin layer of nickel is sandwiched between the metals to be joined. Joining is completed by heating the sandwich to a temperature below the melting point of aluminum and urging the sandwich layers together to produce a solid-state weld. In this way, alloying of aluminum with uranium and consequent formation of intermetallic zones are prevented. In the example presented for this process, 0.25-in. thick nickel was used, and temperatures of 535 to 625°C and pressures of 11 to 25 tons/in^2 for 8 min were found to be satisfactory. (D.L.C.)

7750 APPARATUS AND METHOD FOR INJECTION CASTING. A. B. Shuck (to U. S. Atomic Energy Commission). U. S. Patent 2,952,056. Sept. 13, 1960.

A single-chamber metal casting apparatus is described wherein molten metal in a vertically movable container can be brought directly into contact with molds. By increasing the gas pressure within the chamber the metal is forced upward into the molds.

7751 CASTING FURNACES. R. H. Ruppel and C. E. Winters (to U. S. Atomic Energy Commission). U. S. Patent 2,966,709. Jan. 3, 1961.

A device is described for casting uranium which comprises a crucible, a rotatable table holding a plurality of molds, and a shell around both the crucible and the table. The bottom of the crucible has an eccentrically arranged pouring hole aligned with one of the molds at a time. The shell can be connected with a vacuum.

7752 FUSION WELDING METHOD AND APPARATUS. W. L. Wyman and W. I. Steinkamp (to U. S. Atomic Energy Commission). U. S. Patent 2,968,715. Jan. 17, 1961.

An apparatus for the fusion welding of metal pieces at a joint is described. The apparatus comprises a high-vacuum chamber enclosing the metal pieces and a thermionic filament emitter. Sufficient power is applied to the emitter so that when the electron emission therefrom is focused on the joint it has sufficient energy to melt the metal pieces, ionize the metallic vapor above the molten metal, and establish an arc discharge between the joint and the emitter.

Properties and Structure

7753 (58-RL-1963) INTERNAL OXIDATION OF COPPER–ALUMINUM ALLOYS. D. L. Wood (General Electric Co. Research Lab., Schenectady, N. Y.). June 1958. 34p.

An electron microscope study was made of the precipitated oxide particles in internally oxidized copper–aluminum alloys. An abrupt change in the mode of precipitation of the particles occurs in specimens of higher aluminum content. Although the hardness can be qualitatively correlated with oxide particle size and mean free path, variations in particle dispersion appear to have little effect on the yield strength. Rather, the yield strength is strongly dependent on matrix grain size. It is shown that the fine oxide particles have a marked restraint on recrystallization after severe cold-working. (auth)

7754 (AD-240591) REFRACTORY GADOLINIUM AND HAFNIUM COMPOUNDS. Semi-Annual Report for the Period Ending December 31, 1959. (Research Chemicals, Inc., Burbank, Calif.). 35p. Contract NObs-77145. (RC-134).

A summary of activities in an investigation of refractory hafnium and gadolinium compounds is presented. Measurements of Seeback coefficient were obtained along with resistivity and melting point. Data are given on Gd–Sb, Gd–Bi, Gd–Se, Gd–Si, Gd–P, Gd–B, Hf–Si, and Hf–B systems. (J.R.D.)

7755 (ARL-TR-60-321) HIGH-PRESSURE RESEARCH IN METALS AND CERAMICS. Period covered: June 1, 1958 to July 31, 1960. R. E. Hoffman, J. B. Hudson, J. S. Kouvel, W. H. Meiklejohn, D. S. Rodbell, and R. H. Wilson (General Electric Co. Research Lab., Schenectady, N. Y.). Sept. 1960. 79p. Project No. 7021. Contract AF33(616)-5951.

The volume self-diffusion in pure lead was studied at pressures up to 40 kb and at temperatures from the melting point at each pressure to about 150°C below this melting point. The influence of pressure on the melting temperature was obtained from these experiments. Attempts to measure grain boundary self-diffusion by the modified techniques were successful. The magnetizations of iron and nickel at room temperature were studied at pressures up to 3000 atm and fields up to 10,000 oersteds. These measurements of saturation magnetization as a function of hydrostatic pressure were extended to a series of Fe–Ni alloys, and the results were used to interpret the interactions between the atomic moments. From similar measurements on an Fe–Si alloy single crystal, results were obtained for the effect of hydrostatic pressure on the magnetocrystalline anisotropy of this material. A study was made of the effects of hydrostatic pressure on the first-order magnetic transitions in the materials MnAs and $MnAu_2$. (auth)

7756 (BM-RI-5688) ZIRCONIUM–DYSPROSIUM EQUILIBRIUM DIAGRAM. J. Croeni, C. E. Armantrout, and H. Kato (Bureau of Mines, Washington, D. C.). Sept. 10, 1959. 14p.

The zirconium–dysprosium system was investigated by melting point, thermal analysis, resistivity, x-ray, and metallographic methods. Results indicate a single eutectic system with a peritectoid reaction occurring at 890°C. The eutectoid isotherm extends from 30 to 95% dysprosium at 1280°C. Solid solubility of dysprosium in α and β zirconium is extensive. No definite values are given for the extent or solid solubility of zirconium in dysprosium. (J.R.D.)

7757 (BMI-1479) HIGH-TEMPERATURE COMPATIBILITY OF Al_2O_3–, BeO–, AND METAL-COATED UO_2 PARTICLES WITH GRAPHITE AND COKE. Arnold F. Gerds and Allison K. Smalley (Battelle Memorial Inst., Columbus, Ohio). Nov. 28, 1960. 26p. Contract W-7405-eng-92.

The compatibility of carbon and graphite matrices with UO_2 particles coated with Al_2O_3, BeO, nickel, niobium, and nickel-chromium alloy was investigated at several temperatures up to 3000°F in flowing helium. Two different carbonaceous fillers and binders were used. As expected, the 2 to 8-μ metal coatings were badly damaged by reaction with carbon at temperatures as low as 1700°F. Both oxide coatings were completely destroyed after 6 hr at 3000°F. Considerable reaction between the matrices and Al_2O_3 and BeO coatings occurred during 1000 hr at 2500°F. Coating

damage was more severe in surface particles than in particles located inside the specimens. The graphite filler and pitch binder combination used in this study was less reactive than combinations containing coke filler or resin binder. (auth)

7758 (BMI-1487) PREPARATION AND PROPERTIES OF UO_2 CERMET FUELS. Stan J. Paprocki, Donald L. Keller, George W. Cunningham, and Donald E. Kizer (Battelle Memorial Inst., Columbus, Ohio). Dec. 19, 1960. 64p. Contract W-7405-eng-92.

Sintering, hot-press forging, and gas-pressure bonding were evaluated as techniques for preparing cermet fuel materials containing at least 60 vol. % UO_2 and having a minimum density of 90% of theoretical. Minus 325-mesh chromium, molybdenum, niobium, and Type 302B stainless steel were employed as matrix materials. Hydrothermal and spherical UO_2 powders were evaluated. Cermets containing 80 vol. % UO_2 and exhibiting densities in excess of 90% of theoretical were successfully prepared by both hot-press forging and by gas-pressure bonding mixed oxide and metal powders. Gas-pressure bonding produced specimens with a more uniform structure and was demonstrated to be capable of simultaneously densifying and cladding green-pressed cermet fuels. Spherical UO_2 powders produced the more homogeneous microstructures. Excellent microstructures were also obtained by the use of UO_2 powder coated with niobium by vapor-deposition techniques. So far as direct comparison is possible the cermets were superior in strength to UO_2. Strength, which was measured by bend and compression tests, was density dependent. Thermal-conductivity values for the cermets were far higher than values for UO_2. Electrical-resistivity data were also obtained. These data were used to develop a mathematical correlation of electrical and thermal conductivity but a complete analysis could not be made on the basis of present theories due to the limited number of measurements made. (auth)

7759 (BNL-633) ABSORPTION AND DIFFUSION OF XENON IN HIGH DENSITY GRAPHITE AT HIGH TEMPERATURES. Frank J. Salzano and Allen M. Eshaya (Brookhaven National Lab., Upton, N. Y.). Sept. 1960. 16p.

The absorption isotherms of xenon on type G.S.-R4 high-density graphite were measured at 750 and 1000°C by using radioactive tracer xenon. A technique was developed by which graphite at high temperature is equilibrated with radioactive xenon and the sample quenched in cold mercury to seal in the absorbed gas. The measured magnitudes of the absorption and the shapes of the isotherms indicate that by far the greatest fraction of the sorbed gas is contained within the accessible pores of the graphite. It was found that the absorption can be expressed by the equation $A_g = Pv_vN/RT$ where A_g is the number of atoms absorbed per gram, v_v is the void volume per gram, N is Avogadro's number, R is the universal gas constant, T is the absolute temperature, and P is the partial pressure of the xenon. A comparison of the measured and theoretical densities, in conjunction with the measured absorptions, indicates that the xenon has completely filled the pores of the graphite. As a result of this work an explanation is offered for the high concentrations of fission xenon found on graphite surfaces. Measurements of the rate of diffusion of xenon into evacuated graphite at 750 and 1000°C were made by equilibrating for time intervals shorter than those required to achieve equilibrium. Considerable variation in rates of absorption was found for the same type of graphite fabricated as round stock and flat stock. The experimental data are discussed in the light of the postulated transport mechanism. (auth)

7760 (CF-60-10-131) ESTIMATION OF REACTION AND HEAT RELEASE RATES FOR GRAPHITE OXIDATION. John W. Prados (Oak Ridge National Lab., Tenn.). Oct. 19, 1960. 31p. Contract [W-7405-eng-26].

A literature study of rates for the reaction of oxygen with high-purity artificial graphite was made. Values from a number of sources were expressed on a common basis, which provides approximate correction for the retarding effects of oxygen diffusion in the graphite pores. The corrected rates can be correlated by the equation $k = 7.24 \times 10^9 \exp(-22\,100/T)$, where k has units of weight fraction oxidized per hour and T is in °K. Effects of oxygen concentration, solid and gas-phase contaminants, and radiation on the observed rates are discussed. Methods for estimating rates and spatial distribution of heat release during graphite oxidation are presented. (auth)

7761 (GA-1508) MARITIME GAS-COOLED REACTOR PROGRAM. REACTOR MATERIALS COMPATIBILITY WITH IMPURITIES IN HELIUM. J. C. Bokros and H. E. Shoemaker (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Jan. 12, 1961. 74p. Contract AT(04-3)-187.

Results are presented of an investigation to determine the maximum permissible partial pressure of carbon dioxide that could be tolerated in the Maritime Gas Cooled Reactor system without oxidizing and embrittling niobium and its alloys, and to screen the heat-resistant nickel- and iron-base alloys for resistance to oxidation and carburization by hydrogen, carbon dioxide, and carbon monoxide. The effect of hydrogen additions on carburization of heat-resisting alloys and on the decomposition of carbon monoxide was also studied along with the catalytic effects of heat-resisting alloys on disproportionation of carbon monoxide. (J.R.D.)

7762 (GEAP-3530) METALLURGICAL STABILITY OF SEVERAL BORIDE DISPERSION SYSTEMS. K. C. Antony and W. V. Cummings (General Electric Co. Atomic Power Equipment Dept., Pleasanton, Calif.). Sept. 20, 1960. 28p. Contract AT(04-3)-189.

The metallurgical stability (compatibility) of 80 different boride-metal systems was determined experimentally. Specifically, the compatibility of some MB_2 borides (HfB_2, TiB_2, VB_2, ZrB_2), MB_4 borides (B_4C, YB_4), and MB_6 borides (CaB_6, EuB_6, SmB_6, and YB_6) with the metals Ti, Zr, Fe, stainless steel (304), Ni, Cu, Ag, and Al, respectively, was determined using the methods of x ray diffraction and metallography. Determinations were made on disperse powder samples at temperatures and times consistent with anticipated fabrication parameters. (auth)

7763 (HW-65019) MECHANICAL PROPERTY AND FORMABILITY STUDIES ON UNALLOYED PLUTONIUM. H. R. Gardner and I. B. Mann (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Dec. 1959. 91p. Contract AT(45-1)-1350.

The effect of temperature and testing speed on the tension and compression properties of unalloyed plutonium was studied in the α, β, γ, and δ phases. Compressive formability data were obtained for a load of 100,000 lbs in the aforementioned phases. In addition, preliminary creep, tension impact, and torsion data for α-phase plutonium are reported. Extrusion constants and pressures for the β, γ, and δ phases were obtained. The room-temperature tension and compression properties of the β- and γ-extruded plutonium were determined. Metallo-

graphic studies were made to determine the effect of tension, compression, and extrusion, in the indicated phases, on the microstructure of as-cast plutonium. (auth)

7764 (KAPL-1957) MELTING POINTS IN THE SYSTEM PuO_2–UO_2. S. W. Pijanowski and L. S. DeLuca (Knolls Atomic Power Lab., Schenectady, N. Y.). Apr. 15, 1960. 8p. Contract W-31-109-Eng-52.

The melting points of PuO_2 in hydrogen and helium atmosphere were measured. The liquidus curve in the composition range of pure UO_2 to 80 mole % UO_2 was determined. Partial reduction of the PuO_2 occurred in hydrogen and resulted in a second unidentified phase in the cooled residue. (auth)

7765 (KAPL-M-AEB-9) HYDRIDE APPEARANCE AND DISTRIBUTION IN ZIRCONIUM BASE ALLOYS. A. E. Bibb (Knolls Atomic Power Lab., Schenectady, N. Y.). Dec. 14, 1960. 24p. Contract W-31-109-Eng-52.

A summary of observations on the appearance and distribution of hydrides in zirconium-base alloys is presented. It is shown that the hydrides may be precipitated on habit planes within grains or at grain boundaries, regardless of whether the hydrogen is introduced during corrosion in aqueous media or by means of a Sieverts type apparatus. Hydrogen is found to move toward the coolest section of zirconium-base alloys. It is noted that the severity of etching and the magnification of examination must be evaluated if they are used in reaching conclusions concerning the appearance and distribution of hydrides. (J.R.D.)

7766 (KAPL-M-AXP-1) CONDUCTIVITY IN AGGREGATES. A. E. Powers (Knolls Atomic Power Lab., Schenectady, N. Y.). Sept. 13, 1960. 50p. Contract W-31-109-Eng-52.

A survey of methods and equations for calculating the electric and thermal conductivity of aggregates was made. The equations are correlated and classified according to the basic assumptions concerning the nature of the aggregate. Derivations are presented in order that the applicability of the equations may be better understood, and the nature of these relations are shown by presenting graphic examples. Conductivity in aggregates containing spherical, nonspherical, and coated particles is treated quantitatively. (auth)

7767 (KAPL-M-LSD-1) LITHIUM–ZIRCONIUM REACTION STUDIES, PRELIMINARY REPORT. L. S. DeLuca (Knolls Atomic Power Lab., Schenectady, N. Y.). Aug. 30, 1960. 28p. Contract W-31-109-Eng-52.

The addition of lithium in parts per million quantities lowers the corrosion resistance and raises the tensile strength of zirconium. The diffusion of lithium on Zircaloy-2 was studied in the range 775 to 850°C. The results obtained can be fitted to the following equation: $D = 0.73\ (-33{,}700/RT)\ cm^2/sec$. (auth)

7768 (NAA-SR-Memo-5752) CATHODIC ETCHING. K. R. Janowski and E. Tagliaferri (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Oct. 4, 1960. 11p.

The design and use of an ionic bombardment etcher is described. Examples of its application on metals and alloys such as stainless steel, zinc, zirconium hydride, and a lead–tin alloy are included. (J.R.D.)

7769 (NAA-SR-Memo-5769) SOME ASPECTS OF THE CARBON–OXYGEN–SODIUM SYSTEM. D. L. Johnson (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Oct. 7, 1960. 16p.

A program for study of equilibrium conditions in liquid sodium-gas-solid systems and to correlate phase compositions with degree of interaction between these phases is presented. Carburization potential of the gas phase was estimated for dilute solutions of carbon and oxygen in sodium. These data indicate the existence of a critical relation between sodium composition and the resulting gas composition. Equipment for analysis to determine carbon monoxide and carbon dioxide by gas chromatography is being developed. (J.R.D.)

7770 (NAA-SR-Memo-5773) KINETICS OF THE OXIDATION OF A THORIA-10 w/o URANIA SINTERED PELLET. T. Smith (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Oct. 19, 1960. 7p.

A thoria–10 wt.% urania sintered pellet was oxidized at temperatures from 600 to 950°C and 779 mm Hg oxygen pressure. The rate of oxidation can be expressed as: $R = 3.7 \times 10^{-3}\ e^{-22{,}500/RT}$ moles O_2/cm^2-min from 800 to 950°C. The pellet was not pulverized under the experimental conditions. (auth)

7771 (NAA-SR-Memo-5842) PHYSICAL CONDITION OF SRE ZIRCONIUM. J. J. Gill (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Nov. 1, 1960. 11p.

A cursory examination to determine the effect of SRE irradiation and sodium exposure on the zirconium cladding material was carried out. Chemical analysis, simple bend tests, and metallography were performed on specimens removed from moderator cans. No grain growth occurred at the normal reactor operating temperatures of 500 to 950°F. Increases in the oxygen and hydrogen contents to as much as 3300 and 1000 parts per million, respectively, resulted from reactor exposure. The increase in hydrogen content causes the zirconium to be very brittle at room temperature. At approximately 200°F and above, the ductility of the SRE-exposed zirconium is similar to that of as-received material. Except for the addition of surface oxide which could possibly reduce the fatigue life, normal SRE exposure to data had little effect upon the properties of the zirconium at reactor operating temperatures. (auth)

7772 (NP-9752) REFRACTORY GADOLINIUM AND HAFNIUM COMPOUNDS. Final Report Covering Period May 18, 1959 to May 1, 1960. R. C. Vickery and H. M. Muir (Research Chemicals, Inc., Burbank, Calif.). May 1960. 95p. Contract NObs-77145. (RC-145)

Gadolinium compositions with bismuth, antimony, silicon, boron, phosphorus, and selenium, and hafnium compounds with silicon and boron were examined for their potential as thermoelectric materials. Seebeck potentials, resistivities, and melting points were determined. Several refractory systems were uncovered, with melting points as high as 3000°C, and compounds in the gadolinium-selenium systems demonstrated a possible value as a thermoelectric material. In the gadolinium-selenium system, Seebeck outputs as high as 500 $\mu v/°C$ were obtained, but this and resistivities were found to vary unconventionally with treatment and mild variations in composition. "Doping" of the Gd_2Se_3 compound composition with small amounts of copper appears to have no advantageous effect upon electrical characteristics of the material, and a tentative investigation of the chemistry of the system has led to the belief that the value of the gadolinium-selenium system for thermoelectric applications depends upon an as yet undetermined relationship between GdSe and Gd_2Se_3 compounds. (auth)

7773 (NP-9758) THERMODYNAMIC PROPERTIES OF BINARY IRON–ALUMINUM ALLOYS. Final Report.

J. Eldridge and K. Komarek (New York Univ., New York. Coll. of Engineering). Dec. 1960. 60p. DA Project No. 5-99-01-004. Contract DA-30-069-ORD-2009.

Thermodynamic properties of solid iron–aluminum alloys were determined by this method at 30 to 75% aluminum and 1100 to 1400°K. The activity of aluminum shows a strong negative deviation from Raoult's law at low concentrations of aluminum but increases rapidly above 40 at. % aluminum. Close to 50 at. % aluminum, the behavior of thermodynamic properties indicates a rapid increase in order as the composition FeAl is approached. A further rapid increase of the activity of aluminum occurs at the intermetallic compound $FeAl_3$. Various molar and partial molar thermodynamic properties were calculated for a temperature of 1200°K. (auth)

7774 (NP-9766) NONDESTRUCTIVE ANALYSIS OF THE BRITTLE FRACTURE BEHAVIOR OF CERAMIC MATERIALS. Quarterly Progress Report No. 1 [Period Covered] September 1, 1960–November 30, 1960. Julian H. Lauchner and Joseph L. Pentecost (Mississippi State Univ., State College). Dec. 1960. 16p. Contract AF33 (616)-7347.

A literature survey of theoretical and experimental approaches to brittle fracture was directed toward nondestructive aspects. Surface decorating techniques were investigated and an experimental brittle fracture study program using glass was established. 46 references. (auth)

7775 (OOR-2178.1) THE EFFECT OF TEMPERATURE ON LOCAL ORDER DIFFUSE SCATTERING FROM ALLOYS. [PART] I. Technical Report 60-1 [on] ARMY DIFFRACTION STUDIES. C. B. Walker (Chicago. Univ. Inst. for the Study of Metals) and D. T. Keating (Brookhaven National Lab., Upton, N. Y.). Nov. 14, 1960. 26p. Sponsored by AEC and DA under Contract DA-11-022-ORD-2803.

The theory of the diffuse scattering of x rays from binary alloys with local order was extended to include explicitly the effects of thermal vibrations. By adopting certain simplifying assumptions about the lattice vibrations, it is found that the thermal effects can be expressed in the form of appropriate Debye-Waller factors modifying the usual diffuse scattering terms. Experimental measurements verify the predicted general nature and magnitude of the temperature effect. Neglect of this effect appears to be a significant source of error in past experimental determinations of local order in alloys. (auth)

7776 (ORNL-2780) THE MECHANICAL PROPERTIES OF INOR-8. R. W. Swindeman (Oak Ridge National Lab., Tenn.). Jan. 27, 1961. 73p. Contract W-7405-eng-26.

Tensile, creep, and relaxation tests were performed on INOR-8, a nickel-base alloy developed for use in the Molten-Salt Reactor. The mechanical properties are summarized and discussed in relation to the composition, microstructure, and environment. The results indicate that the minimum strength properties of INOR-8 are sufficient to permit the use of workable design stresses to 1300°F. Certain areas are pointed out where additional information is desirable. (auth)

7777 (SCNC-293) PHYSICAL AND MECHANICAL PROPERTIES OF YTTRIUM–URANIUM ALLOYS. I. Sheinhartz, K. Moyer, and J. L. Zambrow (Sylvania-Corning Nuclear Corp., Bayside, N. Y.). Aug. 1959. Decl. Jan. 11, 1960. 44p. Contract AT-30-1-GEN-366.

Mixtures of yttrium hydride powders and uranium powders were fabricated into solid yttrium-uranium alloys which were homogeneous dispersions of metallic uranium in a matrix of yttrium. The most satisfactory fabrication procedure was to blend yttrium hydride and uranium powders, compact them at 50 tsi, and sinter at 1100°C in vacuum. Full-density alloys with uranium contents ranging from 5 to 85 wt.%, which contained several particle size fractions of uranium, were fabricated by this process. Metallographic examination of the various alloys indicated that a structure consisting of discrete particles of uranium in a matrix of yttrium was obtained in alloys containing up to 65 wt.% of uranium. Alloys containing 85 wt.% of uranium, on the other hand, consisted of discrete yttrium particles in a uranium matrix. These alloys exhibited no dimensional changes when they were held for extended periods of time at 1000°C; they showed no reaction with sodium at 650°C. The results of elevated temperature hardness and tensile tests for various alloys indicate that they retain mechanical strength up to at least 600°C. The response of the alloys to thermal cycling tests was shown to be largely dependent on composition and uranium particle size. (auth)

7778 (SCTM-39-56(51)) TEMPERATURE DEPENDENCE OF THE RATIO d_{33}/d_{31} IN POLYCRYSTALLINE BARIUM TITANATE AND LEAD ZIRCONATE–TITANATE. C. V. Stephenson (Sandia Corp., Albuquerque, N. Mex.). Mar. 2, 1956. 9p.

The piezoelectric ratio d_{33}/d_{31} was calculated using the resonant-antiresonant measurements of the radial mode of vibration in disks and the thickness mode of vibration in long rods. At −70 to +70°C this ratio was found to vary as much as 30% in some barium–titanate specimens, but was constant for lead zirconate–titanante. (auth)

7779 (TID-11345) SELF-LUBRICATING BEARING MATERIALS. A Literature Search. Myra Scott Feldman (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). Jan. 5, 1961. 13p.

A literature search was made on self-lubricating bearing materials. References were obtained from the following sources: Abstracts of Classified Reports 1956 to 1960, Applied Science and Technology 1955 to 1960, Engineering Index 1955 to 1959, and Nuclear Science Abstracts 1955 to 1960. 70 references. (J.R.D.)

7780 (TID-11497) STUDY OF FACTORS INFLUENCING DUCTILITY OF IRON–ALUMINUM ALLOYS. Monthly Letter Report No. 8 for the Contract Year May 1, 1960 to April 30, 1961. George P. Rauscher, Jr., Frank C. Perkins, and Joseph F. Nachman (Denver. Univ. Denver Research Inst.). Jan. 10, 1961. 7p. Contract AT(11-1)-742.

The effects of variations of aluminum content, heat treatment, surface preparation, and other metallurgical factors upon the room-temperature ductility of Fe-Al alloys were investigated. Major efforts were concerned with optimizing the heat-treatment schedules of the Alfenols and determining the resulting mechanical properties. (W.L.H.)

7781 (TID-11583) EXPERIMENTAL GAS COOLED REACTOR—CREEP TEST, AGOT GRAPHITE. P. J. Lain (Allis-Chalmers Mfg. Co. Nuclear Power Dept., Washington, D. C.). Aug. 23, 1960. 13p. (RD-0202).

Tests were conducted to determine the cumulative and permanent deflection of a beam subjected to two-point loading for (1) ambient temperature-atmospheric environment, and (2) 800°F-atmospheric environment, for 800 psi maximum flexural stresses. Deflection curves are given for five specimens. An analysis of the data indicated that if the core graphite creeps while at EGCR conditions by ~1.5

times its creep rate at ambient temperature, the stresses will level off below 1000 psi. Considerable oxidation occurred for two specimens at 800°F. The indicated strain of these specimens may not be representative of AGOT, nuclear grade graphite at 800°F in an inert atmosphere. (B.O.G.)

7782 (USNRDL-TR-484) THERMAL DIFFUSIVITY OF STAINLESS STEEL OVER THE TEMPERATURE RANGE 20°C–1000°C. R. J. Jenkins and R. W. Westover (Naval Radiological Defense Lab., San Francisco). Dec. 5, 1960. 18p.

The thermal diffusivities of 12 different stainless steels are reported at 20 to 1000°C. The thermal diffusivities of the austenitic stainless steels are in the range 0.03 to 0.04 cm^2/sec at 20°C and increase nearly linearly with no discontinuities to near 0.05 cm^2/sec at 1000°C. The martensitic stainless steels start at thermal diffusivities of 0.05 to 0.07 cm^2/sec at 20°C, decrease to about 0.03 cm^2/sec near 700°C, and then increase in thermal diffusivity over the rest of the temperature range studies. The thermal diffusivities measured were stable and did not change in several hours at temperature. (auth)

7783 (WADD-TR-60-184) EFFECT OF BASIC PHYSICAL PARAMETERS ON ENGINEERING PROPERTIES OF INTERMETALLIC COMPOUNDS. [Period covered]: December 1958 to December 1959. D. L. Wood and J. H. Westbrook (General Electric Co. Research Lab., Schenectady, N. Y.). Mar. 31, 1960. 33p. Project No. 7350. Contract AF33(616)-6144. OTS.

A method for producing sound, uniform, and reproducible test specimens was devised, and an investigation made of the effects of basic physical parameters on the mechanical properties. Tensile test specimens of Bi_2Tl and AgMg, produced directly by extrusion, have provided information applicable to future studies of the properties of NiAl. A pronounced yield point is found in AgMg; high strain-rate sensitivity of the yield stress was observed and the effects of grain size, composition, and test temperature were documented. Specimens will withstand loading only at very slow strain rates; after yielding occurs, however, rapid strain rates may be employed. With total elongations of more than 50%, the material is ductile under previously brittle conditions. (auth)

7784 (WT-1473) COMPARISON TEST OF REINFORCING STEELS. Final Report. R. H. Carlson and J. P. Murtha (Sandia Corp., Albuquerque, N. Mex.). Oct. 1959. 108p. Project 34.2 [of] OPERATION PLUMBBOB.

Project 34.2 was planned to determine the relative merits of rail- and intermediate-grade steel as reinforcement in concrete slabs subjected to blast loading. Slab pairs were placed at ground level over deflection chambers and loaded with the incident pressure pulse from a nuclear device. Two station locations were chosen so that the loadings were approximately 7 and 5 psi peak overpressure. The slabs comprising each pair were identical except for the grade of reinforcement in each. Slab strengths were varied, and two test stations were used to increase the probability of realizing the response necessary to emphasize the advantages of each steel grade. Measurements were made of the dynamic midspan slab deflections and the transient loading pulse. A thorough posttest survey was conducted to determine the severity of the resulting damage to the concrete slabs. Test results indicated that the desired range of slab behavior was achieved. In all cases the rail slabs displayed the more desirable response. However, limitations of this experiment, due to loading and structural conditions, must be considered before this conclusion can be generalized. (auth)

7785 (AEC-tr-4386) ON THE STRUCTURE OF METALLIC URANIUM. J. Friedel. Translated from Phys. and Chem. Solids 1, 175-87(1956). 27p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 11, as Abstract No. 2883.

7786 (AEC-tr-4388) EMBRITTLEMENT OF METALS BY HYDROGEN. THE EFFECT OF THE CRYSTALLOGRAPHIC AND ELECTRON STRUCTURE. (La Fragilisation des Métaux par l'Hydrogène. Influence de la Structure Cristallographique et Électronique). P. Blanchard and A. R. Troiano. Translated by Al Monks (Oak Ridge National Lab.) from Mém. sci. rev. mét. 57, 409-22(1960). 36p. (Includes original, 14p.).

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, as Abstract No. 23335.

7787 (AEC-tr-4399) THERMOCYCLING OF URANIUM ALPHA. Hubert Bairiot. Translated from Soc. rpy. belge ingrs. et industriels No. 3, 101-26(1960). 56p. JCL

A review of information on thermocycling damage to α-uranium and the main experimental data published to date are presented. The mechanisms of thermal racheting and of crystalline flow are described theoretically. Micrographic tests, with measurements of local deformations for each crystal, make it possible to observe that the characteristic lengthening of materials having a preferential orientation is localized to the crystals with an [010] axis little inclined in the direction of macroscopic lengthening. A new theory is proposed, based on the unblocking of dislocations by regressing macles; it leads to a lengthening coefficient $Gt = (\alpha_{(010)} - \alpha_{[010]})(T_h - T_c)PS$ which accounts for all the observed phenomena and makes it possible to orient the choice and the working conditions of a nuclear fuel in order to decrease the influence of the internal thermocycling in damage caused by radiation. (auth)

7788 (AEC-tr-4404) APPROXIMATE ESTIMATION OF CRITICAL TEMPERATURES OF METALLIC LIQUIDS. S. N. Zadumkin. Translated from Inzhener.-Fiz. Zhur., Akad. Nauk Belorus. S.S.R. 3, No. 10, 63-5(1960). 4p.

An approximation of critical temperatures of metals based on elementary statistical theory of the surface tension is given. Critical temperatures of several metals were calculated and were found to correspond approximately to the relation $T_{cr} \approx 3T_{boil}$. (J.R.D.)

7789 (AEC-tr-4407) INTERNAL FRICTION IN URANIUM. A. I. Dashkovskii, A. I. Evstyukhin, E. M. Savitskii, and D. M. Skorov. Translated by S. J. Rothman (Argonne National Lab.) from Atomnaya Energ. 9, 27(1960). 7p.

This paper was previously abstracted from the original language and appears in NSA, Volume 14, as Abstract No. 22046. (auth)

7790 (HW-tr-21) COMPARISON OF THE INFLUENCE OF SMALL ADDITIONS OF CHROMIUM, IRON OR MOLYBDENUM ON THE TRANSFORMATIONS UNDERGONE BY URANIUM DURING QUENCHING AND SUBSEQUENT ANNEALING. J. Delaplace. Translated by Liz Appleby from Mem. sci. rev. met. 57, 721-7(1960). 16p.

The effects of cooling on the nature and kinetics of the transformation produced during the quench and during subsequent annealing at ambient temperature in uranium containing traces of alloyed chromium, iron, or molybdenum were examined. (J.R.D.)

7791 (NP-tr-539) Al–Cu–Mg SYSTEM. G. G. Urazov and M. S. Mirgalovskaya. Translated by J. J. Cornish (U.K.A.E.A. Atomic Energy Research Establishment, Harwell) from Doklady Akad. Nauk S.S.S.R. 83, 247-50(1952). 8p.

Three-dimensional constitution diagrams for the aluminum–copper–magnesium system are presented. (J.R.D.)

7792 (NP-tr-540) EQUILIBRIUM STUDIES IN THE ZINC–ALUMINIUM AND ZINC–ALUMINIUM–COPPER SYSTEMS. Erich Gebhardt. Translated by L. F. Secretan (U.K.A.E.A. Atomic Energy Research Establishment) from Z. Metallk. 40, 136-40(1949). 16p.

The melting equilibria were investigated in the zinc-aluminum-copper ternary system for temperature-concentration sections with constant copper contents of 1, 2, and 3%. Thermal analysis was used to determine the liquidus temperatures, whereas the solidus temperatures were determined microscopically on homogenized samples by the melted-drop method. Melting equilibria in the zinc-aluminum binary system were included in the investigations. The shapes of the liquidus and solidus surfaces in the range of the compositions investigated were determined accurately by investigating adjacent ternary sections. In the temperature-composition section for 3% Cu, the phase boundaries in the solid state were determined, as well as the melting equilibria. Special attention was paid to the solubility curve for the homogeneous aluminum solid solutions, which is very dependent on temperature; and, in this range of composition, various types of heat treatment were carried out for age-hardening. However, the increases in hardness which resulted were slight. (auth)

7793 (SCL-T-354) STRUCTURE AND ALLOTROPIC TRANSFORMATION OF COBALT. (Structure et Transformation Allotropique du Cobalt). Hervé Bibring and François Sebilleau. Translated by Marcel I. Weinreich from Rev. mét. 52, 569-78(1955). 24p.

An investigation of recrystallization effects on the allotropic transformation in the structure of cobalt is described. Optical micrography, differential dilatometry, and x-ray diffraction were the methods used. Experimental techniques and results are discussed, and conclusions are listed. (J.R.D.)

7794 DIFFUSION IN THE SYSTEM URANIUM–TITANIUM. Y. Adda (Centre d'Etudes Nucléaires, Saclay, France) and J. Philibert. Acta Met. 8, 700-10(1960) Oct. (In French)

The intermetallic diffusion in Ti–U alloys is studied at 650 to 1050°C by metallography, microhardness, and the Castaing microanalyser. The diffusion coefficient, the frequency factors, and the activation energies were determined in the γ phase (centered cubic) for uranium concentrations of 0.05 to 0.9. An important Kirkendall effect was in evidence and the intrinsic diffusion coefficients of uranium and titanium were calculated on the basis of Darken's relations. The results compared to those previously obtained for Zr–U alloys, show that the mobility of titanium atoms is higher than that of zirconium atoms. Furthermore, the supersaturation vacancies from the Kirkendall effect was evaluated to explain the difference in porosity observed in the couples U–Zr and Ti–U. Values of $\sim 10^{-3}$ were found for the two couples. It is concluded that the difference in porosity is caused by different conditions of nucleation. (auth)

7795 ON THE TEMPERATURE DEPENDENCE OF FLOW STRESS IN QUENCHED ALUMINUM CRYSTALS. L. E. Tanner (Manufacturing Lab., Inc., Cambridge, Mass.). Acta Met. 8, 730-2(1960) Oct.

An investigation was made of the quenching effects on the temperature dependence of flow stresses in aluminum crystals. The orientations of stress axes of single crystals of aluminum are shown. The samples were strained in an Instron machine, utilizing a specially designed tensile fixture and cryostat at combinations of the following temperatures: 78, 200, 273, and 293°K. In addition to the cycling tests, uninterrupted tensile tests on crystals with widely different orientations were performed at 78 and 293°K. Cycling-test results indicate that quenched crystals not only behave in a manner similar to fully annealed ones, but the numerical values for this relation are quite nearly identical. A plot of the results indicated that the flow stress ratio is independent of dislocation density increase produced by plastic deformation. Additional identical behavior was seen in the presence of "work softening" in the load-extension curves. The evidence presented seems to indicate that, despite the apparent extreme changes in the quenching deformation process, certain areas remain unaffected. This leads to the suggestion that the "forest" effect is important in explaining the mechanical behavior of aluminum crystals independent of prior thermal history. (B.O.G.)

7796 THE LOW TEMPERATURE TENSILE PROPERTIES OF NIOBIUM. A. A. Johnson (Imperial Coll., London, Eng.). Acta Met. 8, 737-40(1960) Oct.

The tensile yield stress, σ_y, of b.c.c. metals was shown to vary with grain diameter $2d$, according to the relation $\sigma_y = \sigma_i + k_y d^{-\frac{1}{2}}$. Experiments were conducted to study the grain-size dependence of tensile properties of niobium at low temperatures with the intention of obtaining the temperature dependence of σ_i and k_y, the lattice friction stresses. Complete brittleness was not observed even at 20°K, the lowest temperature investigated. Specimens were prepared from a swaged rod of sinter niobium, annealed at 1100 to 2300°C and machined to 0.75-in.-gage lengths and 0.10- or 0.05-in.-gage diameters. The 0.10-in. specimens were tested at 76, 195, and 273°K at strain rates of 0.88×10^{-4} sec^{-1}, but the 0.05-in. specimens were tested at 20°K at a strain rate of 2.82×10^{-4} sec^{-1}. At 195 and 293°K, the shape of the load-elongation curves was completely independent of grain size. This was practically true at 76°K, but the results suggest an increase in preyield plastic strain with increasing grain size. The discontinuities in the Hooke's law shown in the load-elongation curves for 20°K were accompanied by audible clicks and were assumed to be caused by mechanical twinning, adiabatic slip, or a combination of the two. The yield and fracture stress results showed more scatter than those at higher temperatures, but no evidence for systematic grain size effects was present. (B.O.G.)

7797 EFFECT OF FERROUS OXIDE ON ZIRCON SAND AT 1200°C. Ralph G. Wells, Lawrence H. Van Vlack, and Ronald Lalonde (Univ. of Michigan, Ann Arbor). Am. Ceram. Soc. Bull. 39, 735-9(1960) Dec.

At 1200°C there are three compatibility triangles in the system $FeO–ZrO_2–SiO_2$: fayalite, tridymite, and zircon; fayalite, zircon, and zirconia; and fayalite, zirconia, and wüstite. The joins $FeO–ZrO_2$ and $Fe_2SiO_4–ZrO_2$ are binary systems. The former has a eutectic near 1320°C, and the latter has a eutectic near 1180°C. $Fe_2SiO_4–ZrSiO_4$ is not a binary system at all temperatures, for zircon dissociates into zirconia and silica above 1500°C. At 1200°C a region of liquid is found surrounding the fayalite composition and extending into each of the three compatibility regions. Fer-

rous oxide at 1200°C causes a dissociation of zircon sand and the formation of an iron-rich silicate liquid. The amount of liquid formed is similar to that formed by ferrous oxide in silica sand at this temperature. (auth)

7798 ELECTRIC PROPERTIES OF $BaTiO_3$ ACTIVATED BY RARE EARTHS. A. F. Yatsenko and T. P. Popova (Rostov-on-Don State Univ., USSR). Izvest Akad. Nauk S.S.S.R., Ser. Fiz., 24, 1311-13(1960) Nov. (In Russian)

The influence of rare earth elements on the electrical properties of $BaTiO_3$ was studied in prepared specimens containing 0.1 to 3 mole % rare earth oxides: Sm_2O_2, Pr_2O_3, Nd_2O_3, Y_2O_3, Tb_2O_3, Dy_2O_3, Eu_2O_3, Lu_2O_3, Te_2O_3, Yb_2O_3, and Gd_2O_3. The temperature dependence and the tangent of the angle of loss was measured at 50 v and ν = 1000 Hertz. (R.V.J.)

7799 RESULTS OF STUDIES OF $PbO-Nb_2O_5-Nd_2O_3$. E. G. Smazhevskaya and N. A. Podol'ner. Izvest. Akad. Nauk S.S.S.R., Ser. Fiz. 24, 1394-7(1960) Nov. (In Russian)

Preliminary results of investigations of $PbO-Nb_2O_5-Nd_2O_3$ containing 0.5 to 10 mole % Nd_2O_3 show that polycrystalline specimens containing 4 to 5 mole % Nd_2O_3 possess a piezomodulus d_3, of the order 0.6×10^{-6} units (cgs), dielectric penetrability of the order 500, and Curie points above 450°C. A limited solid solution with a face centered cubic lattice characteristic of $3PbO-2Nb_2O_5$ forms in the $PbO-Nb_2O_5-Nd_2O_3$ system. The properties of prepared compounds of $PbO \cdot Nd_2O_3$ resemble corresponding compounds of cerium. (R.V.J.)

7800 THERMAL CONDUCTIVITY OF UO_2 TO 2100°C. R. D. Reiswig (Los Alamos Scientific Lab., N. Mex.). J. Am. Ceram. Soc. 44, 48-9(1961) Jan.

The thermal conductivity of UO_2 was measured from 833 to 2112°C using UO_2 disks of 85% theoretical density and the radial heat flow method. The data were corrected to theoretical density and plotted vs. temperature along with the data of W. D. Kingery et al, and Hedge and Fieldhouse; the equation for the least squares fit curve is $k = 1/(17.3 \pm 0.016\ T)$, where k is in watts/cm °C and T is in °K. Power loss as a possible source of error is discussed, and it is concluded that all the errors from power loss would cause an error in k of not more than 15 to 20%. (D.L.C.)

7801 PHASE EQUILIBRIA IN THE SYSTEM CADMIUM OXIDE–NIOBIUM OXIDE. R. S. Roth (National Bureau of Standards, Washington, D. C.). J. Am. Ceram. Soc. 44, 49-50(1961) Jan.

The binary system $CdO-Nb_2O_5$ was studied using quenching methods and sealed platinum tubes. Pure CdO and samples containing free CdO showed a decrease of crystallinity of the CdO structure with grinding, and attempts to determine the melting point of pure CdO up to 1500°C resulted only in sublimation. Two compounds are formed in the system, $2CdO \cdot Nb_2O_5$, and $CdO \cdot Nb_2O_5$, and their structures are reported. The eutectic compositions for the pairs $2CdO \cdot Nb_2O_5-CdO \cdot Nb_2O_5$ and $CdO \cdot Nb_2O_5-Nb_2O_5$ are estimated to lie at 66.7 to 60 and 33.3 mole % CdO, respectively; the eutectic composition and temperature for the other pair, $CdO-2CdO \cdot Nb_2O_5$, could not be determined. Liquidus data were difficult to obtain because of the high volatility and fluidity of CdO at high temperatures. A phase equilibrium diagram with tentative liquidus curves is presented. (D.L.C.)

7802 ELECTRICAL RESISTIVITIES OF NICKEL–NIOBIUM SOLID SOLUTIONS. Sigurds Arajs (U. S. Steel Corp. Research Center, Monroeville, Penna.). J. Appl. Phys. 32, 97-9(1961) Jan.

The electrical resistivities of nickel-rich nickel–niobium solid solutions were determined from liquid-helium temperatures to 1000°K. The Matthiessen rule is not obeyed at any temperature. The addition of niobium to nickel increases its ideal electrical resistivity when the alloy is in the ferromagnetic state but decreases it in the paramagnetic region. Dissolved niobium in nickel at liquid-helium temperatures causes considerably larger perturbation for the conduction electron transport than either copper or palladium. (auth)

7803 ELASTIC CONSTANTS OF SINGLE CRYSTALS OF THE bcc TRANSITION ELEMENTS V, Nb, AND Ta. D. I. Bolef (Westinghouse Research Labs., Pittsburgh). J. Appl. Phys. 32, 100-5(1961) Jan.

Values of the elastic constants of single crystals of the bcc transition elements vanadium, niobium, and tantalum are reported at T = 27°C. They are, in units of 10^{11} d/cm^2 for c_{11}, c_{12}, and c_{44}: V–22.8, 11.9, 4.26; Nb–24.6, 13.4, 2.87; and Ta–26.7, 16.1, 8.25, respectively. Comparisons are made of the values obtained for two crystals each of vanadium and tantalum. A high-frequency cw resonance technique was used in the measurements. The shear anisotropies $A = 2c_{44}/(c_{11} - c_{12})$ are anomalously small for these elements as compared to other cubic system elements. An analysis of the shear anisotropy, based on Fuchs' model, is given. It is found essential to consider next-nearest as well as nearest-neighbor ion-ion interactions. (auth)

7804 SURVEY OF VARIOUS SPECIAL TESTS USED TO DETERMINE ELASTIC, PLASTIC, AND RUPTURE PROPERTIES OF METALS AT ELEVATED TEMPERATURES. F. Garofalo (U. S. Steel Corp. Research Center, Monroeville, Penna.). J. Basic Eng. 82, 867-81(1960) Dec.

Testing techniques employed in determining the elastic moduli, i.e., Young's modulus, shear modulus, and Poisson's ratio, at room and elevated temperatures are described. The techniques depend on static or dynamic measurements. A comparison and an analysis of test results determined by the methods are presented. The effect of composition, grain size, and various transformations on the elastic moduli or their temperature dependence is discussed. A review of techniques and experimental data on the effect of high strain rates on plastic and rupture behavior of metals and alloys at elevated temperatures is presented. It is shown that recovery effects explain qualitatively the results obtained. A brief description of the various stages of recovery is presented. The variation of hardness with temperature is discussed for pure metals and alloys, including a description of a typical hot-hardness tester. The relationship between hardness and tensile strength, creep, and creep-rupture behavior is summarized. The use of the hot-hardness tester as a research tool for following solid-state reactions at elevated temperatures is discussed. The reactions may depend on temperature, time, or plastic strain, or a combination of these. (auth)

7805 DISTRIBUTION OF PROTACTINIUM-233 BETWEEN MAGNESIUM-38% THORIUM AND URANIUM-RICH SOLUTIONS. Premo Chiotti, P. F. Woerner, and K. L. Malaby (Iowa State Univ., Ames). J. Chem. Eng. Data 5, 435-6(1960) Oct. (IS-79)

Magnesium–38% thorium alloy was irradiated with thermal neutrons to a total dose of 8 to 9×10^{15} nvt and then charged into tantalum crucibles with uranium or U–5.2% Cr; the crucibles were sealed and heated in an oscillating furnace, then cooled. The resulting ingots were sectioned horizontally and the sections analyzed for the 90-kev γ ray from Pa^{233} formed by irradiated thorium as

a precursor to U^{233}. The data showed little activity in the Mg–Th phase and high activity in the interface, ingot surface turnings, and the uranium or U–Cr phase, indicating that >99% of protactinium will follow the uranium-rich phase in the extraction of thorium from uranium with magnesium. (D.L.C.)

7806 THERMODYNAMIC PROPERTIES OF SODIUM. Munzer Makansi, W. A. Selke, and C. F. Bonilla (Columbia Univ., New York). J. Chem. Eng. Data 5, 441-52(1960) Oct.

Data are tabulated for the thermodynamic properties of sodium at saturated pressures at 426 to 1856.3°K and in the superheated region at 426 to 2600°K for pressures of 10^{-6} to 50 atm absolute. The temperature-entropy chart covers the regions 200 to 4200°F and 0 to 3.3 entropy units. A specific volume as a function of temperature curve is given for pressures of 10^{-4} to 50 atm absolute. 39 references are cited. (B.O.G.)

7807 THE π ELECTRON PROPERTIES OF GRAPHITE. T. E. Peacock (University College, London, England). J. chim. phys. 57, 844-7(1960) Oct. (In English)

The approximation of the theory of molecular orbitals with self-consistent field, utilized to calculate the distribution of the π electrons in aromatic molecules, was recently extended to sheets of bidimensional graphite (Proc. Phys. Soc. 74, 384(1959)). In the present work the results obtained in that calculation are used to discuss some of the physical properties of graphite. (tr-auth)

7808 THE EFFECT OF THERMAL CYCLING ON THE CREEP OF URANIUM. W. S. Blackburn, G. Harnby, and J. J. Stobo (Nuclear Research Centre, Fossway, Newcastle-upon-Tyne, Eng.). J. Nuclear Energy, Pt. A. Reactor Sci. 12, 162-71(1960).

Experiments on the creep of uranium, carried out isothermally at 500°C and with temperature cycles of ±40°C about this temperature, show the considerable effect that cycling has on the creep rate; for example, creep acceleration at 0.5 tsi and 500°C is by a factor of at least 25 for cycles of ±40°C. The greater the amplitude of thermal cycling, the greater is the creep rate for a given stress; the effect on creep rate is greater at lower applied stresses for a given thermal cycle. A theory is developed assuming that the internal stresses set up by the differential expansions of the individual crystals are not, of themselves, sufficient to cause plastic flow. The predictions from this theory, of the magnitude of the effect, are in good agreement with the experimental results. (auth)

7809 RARE EARTHS: SIXTEEN NEW METALS ARE READY TO USE. B. Love and E. V. Kleber (Research Chemicals Div., Nuclear Corp. of America). Materials in Design Eng. 52, 135-7(1960) Nov.

A discussion is given concerning the abundance, design properties, and applications of the rare earths, scandium, and yttrium. The development of ion exchange and solvent extraction processes and the application of the processes to the separation of the rare earths have made available larger quantities of these materials. Mechanical properties of pure rare earth metals in both the as-cast and 50% cold-worked condition are tabulated. Oxidation rates of the metals in air are tabulated for temperatures of 95, 205, 390, 750, and 1110°F. Tabulations of electrical and magnetic properties are included. (B.O.G.)

7810 AN X-RAY INVESTIGATION OF SYSTEMS BETWEEN NIOBIUM PENTOXIDE AND CERTAIN ADDITIONAL OXIDES. H. J. Goldschmidt (B.S.A. Group Research Centre, Birmingham, Eng.). Metallurgia 62, 211-18(1960) Nov.

The binary constitutions of Nb_2O_5 with the oxides of Ni, Co, Fe, Cr, V, Ti, Zr, Mo, W, Mg, Ca, Sr, Ba, Ce, Al, and Si were studied on mixtures melted to varying compositions and in a high- and low-temperature condition. The primary solid solubilities in β–Nb_2O_5 are frequently extensive and accompanied by a degree of structural distortion. A number of intermediate niobates are formed for higher second-oxide contents, and details were determined. Among these, the rutile, columbite, hematite, perovskite, and other structure types enter dominantly; and their stability fields, transformations, lattice-dimensional, and other changes are outlined. A major effect is that of the rutile and columbite-type niobates being in certain cases high- and low-temperature allotropic forms to one another. Several new compounds and new isomorphs to known structures were found. Homogeneity ranges, which sometimes are considerable, are a characteristic of these phases, as well as of the primary end solid solutions. A systematic pattern of phase occurrences emerges and is discussed in the light of the periodic table and crystal chemistry. (auth)

7811 AN X-RAY INVESTIGATION OF SYSTEMS BETWEEN NIOBIUM PENTOXIDE AND CERTAIN ADDITIONAL OXIDES. H. J. Goldschmidt (B.S.A. Group Research Centre, Birmingham, Eng.). Metallurgia 62, 241-50(1960) Dec.

7812 NITRIDING OF TITANIUM. Akira Takamura. Nippon Kinzoku Gakkaishi 24, 565-9(1960). (In Japanese)

A kinetic study of the nitriding process of titanium in a nitrogen stream was carried out in order to establish a method to improve the frictional properties of titanium. The diffusion layer formed by nitriding was covered by a very thin compound layer (TiN). The maximum hardness of the diffusion layer was above Vickers 1000, but the rate of its growth was comparatively low. The rate of reaction of titanium with nitrogen was found to follow the parabolic law at 800 to 900°, and the rate-controlling process was considered to be the diffusion process in both the compound layer and the diffusion layer. As the rate of growth of the diffusion layer is considered to be controlled exclusively by the solubility and the diffusion coefficients of nitrogen in α-titanium, both of which are functions of temperature only, it is necessary to operate at higher temperature and for longer times in order to make the hardened layer deeper. However, the nitriding at a temperature above the transformation point of titanium is not practical because of the formation of surface reliefs produced in the course of $\beta \rightarrow \alpha$ transformation and the deformation of material nitrided at high temperature. Therefore it is concluded that the most practical nitriding temperature is about 850°C. The diffusion coefficients of nitrogen in α-titanium and the compound layer were determined at 850°C as follows: $D_\alpha = 1.3 \times 10^{-11}$ cm²/sec and $D_\gamma = 1.4 \times 10^{-12}$ cm²/sec. (auth)

7813 ON THE EFFECTS OF VARIOUS FACTORS ON THE NITROGEN-ABSORPTION OF THE 20% Cr–Fe ALLOY IN NITROGEN. Masazô Okamoto and Ômi Miyakawa. Nippon Kinzoku Gakkaishi 24, 573-7(1960). (In Japanese)

The effects of heating time, temperature, surface condition of specimens, and purity of the gas used, on the high-temperature nitrogen-absorption of 20% Cr-Fe alloy containing 0.1% carbon and 0.2% nitrogen in extremely pure nitrogen atmosphere, were studied. The results obtained were: (1) More nitrogen was absorbed for longer heating. The rate of absorption was reduced gradually as the heating time was more prolonged. (2) Nitrogen was absorbed

most readily when the alloy was heated at 1100 to 1150°C, at which it contained the most austenite. (3) The oxide film formed on the alloy surface appreciably inhibited the nitrogen-absorption of the alloy, while the effect from the presence of oil on the surface did not. The roughness of the alloy surface had some effect on the nitrogen-absorption of the alloy, and the rougher the surface, the greater the rate at which nitrogen was absorbed. (4) When unpurified gas was used, the rate of nitrogen-absorption was more or less retarded. The effect of unpurified gas was more pronounced at relatively lower temperatures. (auth)

7814 ON THE HIGH TEMPERATURE PROPERTIES OF THE Ni-BASE Ni–Cr–Co AUSTENITIC ALLOYS. Katsurô Suenaga. Nippon Kinzoku Gakkaishi 24, 578-80 (1960). (In Japanese)

An investigation was made to evaluate the high-temperature properties of Ni–Cr–Co austenitic alloys containing up to 40% cobalt with chromium fixed at 20%. The alloys were examined at the 20% cold-rolled state after solution-quenching at 1200°C, and the water-quenched state at 1200°C after the cold-rolling. The results were: The alloys harden with the increase of the cobalt content because of the cold-rolling. The recrystallization temperature exists at 800°C, and appears to be a little lowered with an increase of the cobalt content. The bending creep ductility was measured by the deflection in the creep test, the values being smaller in the cold-rolled specimens than that of the water-quenched one at 1200°C after cold rolling. In the cold-rolled specimens, the deflections are very small, and the rupture times are short in alloys of low cobalt content. Among the water-quenched specimens at 1200°C after the cold rolling, the alloy containing about 30% cobalt, a minimum deflection, and a long rupture time were found. The weight increase from heating at 800°C for 100 hr in air is minimum in the 25% cobalt specimen. It can be said that the alloys containing 20 to 30% cobalt are strongest in the high temperature strength. The addition of nitrogen hardens the alloys and raises the recrystallization temperature, and the oxidation resistivity at high temperatures is somewhat improved, although the rupture time in the bending creep test is shortened. (auth)

7815 MATERIALS IN ATOMIC ENERGY. J. G. Ball, ed. (Imperial Coll.). Nuclear Power 5, 79-90(1960) Dec.

A survey is presented of materials in atomic energy. The properties and potentialities of U, Pu, and Th as fuels are reviewed. Stainless steel, Mg, Be, Zr, Al, Nb, V, and Mo are discussed as cladding materials. Graphite, water, organic liquids, and beryllia are compared as reactor moderators. The coolant properties of CO_2, He, N_2, water, organic liquids, hydrogen, and liquid metals are summarized. The rare earths are compared with boron and hafnium as absorbers. Applications of concrete, resin-impregnated wood, polythene, zinc bromide, B, Pb, and Fe as shielding materials are discussed. Recent developments in the use of ferritic steels and concretes as reactor components and in the application of semiconductors as neutron detectors are reviewed. (M.C.G.)

7816 THE USE OF ELECTRON GAS MODIFICATION IN THE EVALUATION OF THE VIBRATION FREQUENCIES AND THE SPECIFIC HEAT OF LITHIUM. B. Dayal and B. Sharan (Banaras Hindu Univ., India). Proc. Roy. Soc. (London) A259, 361-9(1960) Dec. 29.

A secular determinant for the determination of vibration frequencies of lithium was set up by Launay's method, which takes the electron gas into account. Theoretical elastic constants were used in the calculation of the force constants. Frequencies were calculated for 47 points of the first Brillouin zone which gives the value of $3 \times 1000 = 3000$ frequencies by symmetry. Specific heats were calculated by numerical computation in the range 300 to 6°K and show good agreement with the experimental data. The agreement below liquid-air temperatures is surprising in view of the known phase transformation of lithium. (auth)

7817 THE STUDY OF DIFFUSION IN METAL OXIDES WITH THE AID OF RADIOACTIVE ISOTOPES. N. S. Gorbunov and V. I. Izvekov. Uspekhi Fiz. Nauk 72, 273-306(1960) Oct. (In Russian)

Various experimental arrangements for measuring the diffusion coefficients of elements in metal oxides during sintering at high temperatures in controlled atmospheres are described in detail. Methods of producing radioactive films by vacuum evaporation are presented. Generally, the diffusion coefficient D is a function of the change in concentration of the diffusing element with depth of penetration x and the time of diffusion t at the sintering temperature. The mathematical equations for the diffusion coefficient D are presented, and graphical solutions are illustrated. The activation energies and diffusion coefficients for the following systems are summarized in tabular form and discussed in detail in the text for the indicated range of temperatures: Cu^{64} in Cu_2O (800 to 1000°C), Zn^{65} in ZnO (800 to 1300°C), Ca in CaO (850 to 1600°C), Fe^{59} in Al_2O_3 (900 to 1200°C), Fe^{59} in TiO_2 (800 to 1000°C), Sn in SnO_2 (1000 to 1260°C), Pb^{212} in PbO (400 to 600°C), Cr^{51} in Cr_2O_3 (1000 to 1350°C), Fe^{59} in Cr_2O_3, Fe^{55} in FeO, Fe_3O_4, and Fe_2O_3 (700 to 1200°C), Co^{60} in CoO (800 to 1350°C), and Ni^{63} in NiO (1140 to 1400°C). In a similar fashion the available diffusion data on the movement of various tracers in a number of spinels and silicates are summarized and tabulated. (83 references). (TTT)

7818 STRUCTURE INVESTIGATION OF THE CHROMIUM CARBIDE Cr_3C_2 WITH THERMAL NEUTRONS. Dietrich Meinhardt and Otto Krisement (Max-Planck-Institut für Eisenforschung, Düsseldorf, Germany). Z. Naturforsch. 15a, 880-8(1960) Oct. (In German)

A double crystal spectrometer for thermal neutrons was used for a structural investigation of chromium carbide Cr_3C_2. The intensities calculated from the chromium and carbon positions given by Westgren are in disagreement with the measured intensities. The observed powder diffraction pattern of Cr_3C_2 could be fully explained with new carbon positions. (auth)

7819 THE MAGNETIC DEFLECTION OF ELECTRON BEAMS IN THIN IRON FILMS. H. Boersch, W. Raith, and H. Weber (Technische Universität, Berlin). Z. Physik 161, 1-12(1961). (In German)

The deflection of electron beams by the Lorentz force in passing through thin ferromagnetic films is caused by magnetization of the film as well as by the opposed eigenfields. The effect of the eigenfields is dependent on the shape of the film. The experimentally determined dependence of radiation deflection on the shape of the film confirms quantitatively the theoretical considerations. The value obtained by consideration of the eigenfields for magnetization of the film agrees with the saturation magnetization of massive iron. The Faraday effect was used for thickness measurement and testing of the ferromagnetic condition of films. (tr-auth)

7820 STUDY OF THE PHYSICO-CHEMICAL PROPERTIES OF MIXTURES OF THE $CrSi_2$–$MoSi_2$ SYSTEM.

V. S. Aleksashin and V. S. Mikheev. Zhur. Priklad. Khim. 33, 2216-22(1960) Oct. (In Russian)

In view of high-temperature resistance of the individual materials, the properties of the $MoSi_2$ and $CrSi_2$ mixtures were investigated. From the study of the phase diagram of the system, it was established that the two silicides form limited solid solutions, presenting a nonhomogeneous range and consisting of α and β phases in the concentration range 35 to 85% $MoSi_2$. The microhardness of the α solid solution ranged from 960 to 1120 kg/mm^2 and that of the β solid solution phase from 1270 to 1530 kg/mm^2. The mixtures containing 10% $MoSi_2$ (α solid solution), 90% $MoSi_2$ (β solid solution), and 60% $MoSi_2$ (middle of the $\alpha + \beta$ solid solution phases) had the highest hardness. The specific resistivity of the mixture containing 7.5% $MoSi_2$ was found to be 15.540 ohm-mm^2/m; the lowest value, −0.266 ohm-mm^2/m, was presented by the mixture with a composition close to that of pure $MoSi_2$. The β solid solution had the highest temperature resistance. Mixtures containing up to 40 to 50% $CrSi_2$ are interesting as practical refractory materials. (TTT)

7821 THE EFFECT OF ALLOYING ADDITIONS ON THE HYDROGENATION OF STEEL. S. A. Balezin and N. I. Narushevich. Zhur. Priklad. Khim. 33, 2536-41(1960) Nov. (In Russian)

Alloying additions exert a great influence on the solubility of hydrogen in steels during chemical corrosion processes. When the chromium concentration is increased from 4.92 to 15.49%, the solubility of hydrogen is sharply decreased. During the attack of chromium steels in H_2SO_4, the hydrogenation is independent of the rate of dissolution of the steel. When the chromium concentration of the steel increased, the rate of attack increases while the amount of dissolved hydrogen decreases. When the nickel content is increased from 4.94 to 15.48%, the hydrogenation rate, as well as the rate of attack, goes through a maximum at a nickel content of 9.74%. Steels with simultaneous additions of chromium, nickel, and copper are least subject to hydrogenation when exposed to a 5 N H_2SO_4 solution; steels containing nickel and copper absorb less hydrogen than do chromium steels. (TTT)

7822 BORON: SYNTHESIS, STRUCTURE, AND PROPERTIES. PROCEEDINGS OF THE CONFERENCE ON BORON, HELD AT ASBURY PARK, N. J., ON SEPTEMBER 18-19, 1959. J. A. Kohn, W. F. Nye, and G. K. Gaulé, eds. New York, Plenum Press, Inc. 1960. 203p. $8.50.

Papers presented at the Conference on Boron held at Asbury Park, N. J., on Sept. 18 to 19, 1959, are given. The following topics are covered: crystallization, purification, crystal growth, crystal structure, bonding, and physical properties, especially electronic and optical. General boron chemistry is not treated. Separate abstracts have been prepared for each paper. (D.L.C.)

7823 REMARKS ON STRUCTURE AND POLYMORPHISM IN BORON. J. L. Hoard (Cornell Univ., Ithaca, N. Y.). p.1-6 of "Proceedings of the Conference on Boron."

The three-dimensional framework structures of alpha-rhombohedral boron, tetragonal boron, and the boron carbide phase all contain linked B_{12} icosahedra. Half of the atoms in alpha-rhombohedral boron, the polymorph formed at lowest temperatures, are used in delta linkages between icosahedra, and the structure then satisfies the electron counting set by the essentially molecular Longuet-Higgins and Roberts bonding theory. More conventional and apparently stronger linkages to icosahedra are displayed in tetragonal boron and boron carbide. It is doubtful whether icosahedra play any essential role in the complex structure of the most important polymorph, beta-rhombohedral boron. Critical examination of reported powder data shows that beta-rhombohedral boron may be confidently expected from high temperature (>1500°C) preparation with or without fusion and besides the three modifications established by single crystal data there are several other claimants to recognition. The multiplication of structural variants at lower temperatures probably is dictated by kinetic rather than thermodynamic factors. It is suggested that boron prepared by deposition onto heated substrates is especially prone to form monotropes, often as nonstoichiometric borides. (auth)

7824 THE PREPARATION OF HIGH-PURITY BORON BY HOT-WIRE TECHNIQUES. C. F. Powell and J. M. Blocher, Jr. (Battelle Memorial Inst., Columbus, Ohio) and C. J. Ish. p.7-14 of "Proceedings of the Conference on Boron."

Techniques are described for preparing massive, 99.9+% pure boron in 100-g quantities by hydrogen reduction of boron tribromide vapor on tantalum filaments at 1450°C. Deposition rates up to 9 g/hr, with better than 90% recovery of boron from the tribromide, were obtained. Under optimum conditions, the impurity levels in parts per million in the product were as follows: oxygen 33, nitrogen 30, sulfur 50, silicon less than 300, carbon 200, tantalum (filament) 200, and other metals less than 100. No appreciable interdiffusion was observed at the filament–deposit interface. In some cases, the filament was separated mechanically. (auth)

7825 THE MANUFACTURE OF BORON. G. H. Fetterly. P.15-26 of "Proceedings of the Conference on Boron."

A plant used since 1944 for manufacture of massive crystalline boron is described. It has a capacity of ~300 lb/month on continuous operation and yields a product averaging 96 to 98% boron, 1 to 3% carbon, and minor amounts of iron and silicon. The plant consists of a furnace with six heated vertical graphite rods. The furnace is fed with a mixture of gaseous BCl_3 and hydrogen and about 1 lb/hr of boron is deposited on the hot graphite rods. The boron is broken away after the furnace is cooled, giving lumps of shiny-black, conchoidal fracture with a density of 2.33 g/cm^3. Some of the difficulties of the operation and subsequent improvements and methods for BCl_3 production are described. (D.L.C.)

7826 PREPARATION OF BORON FROM BORON CARBIDE. David R. Stern (American Potash & Chemical Corp., Whittier, Calif.). p.27-37 of "Proceedings of the Conference on Boron."

An electrolytic process for the preparation of elemental boron from boron carbide is presented. Included is evidence which shows that the process is one of anodic transfer. Boron of at least 99.8% purity can be made directly from technical-grade materials. Purity is a function of electrolysis voltages and boron carbide purity. Current efficiencies in excess of 95% are obtained and preferred electrolysis conditions are stated. (auth)

7827 PREPARATION OF CRYSTALLINE BORON. J. Yannacakis and N. P. Nies (U. S. Borax Research Corp., Anaheim, Calif.). p.38-41 of "Proceedings of the Conference on Boron."

The method of preparation of crystalline boron involves preparation of Moissan boron of about 89% purity, upgrading the Moissan boron to 95% boron by heating with fluo-

rides, and heating the upgraded boron by radiation in a vacuum. The latter step is accomplished by cold-pressing the powder into rings, stacking the rings to form a hollow cylinder, and heating in excess of 2000°C by means of a resistance heater in the center void. After cooling, the unfused material at the outside of the cylinder is removed mechanically. The fused portion is crushed to the desired particle size, screened, leached with HCl to remove iron, and then washed and dried. The product contains about 99.0% boron. (auth)

7828 VARIOUS PREPARATIONS OF ELEMENTAL BORON. Ray C. Ellis, Jr. (Raytheon Co., Waltham, Mass.). p.42-7 of "Proceedings of the Conference on Boron."

Elemental boron was prepared by the hydrogen reduction of boron bromide on hot wires and by other methods. Crystals up to 0.1 mm in length were grown on a tantalum wire at 1500°C. Boron diffusion into the wire at this temperature was serious. B_4C crystals up to 1 mm in diameter were grown on a graphite disk heated to 2000°C. Infrared transmission, resistivity, and hardness tests were made on the samples. (auth)

7829 UTILIZATION OF BORON FILAMENTS IN VAPOR-PHASE DEPOSITION OF BORON. K. E. Bean and W. E. Medcalf (Eagle-Picher Research Lab., Miami, Okla.). p.48-58 of "Proceedings of the Conference on Boron."

An investigation has been made of several materials for use as filament substrates in the vapor-phase deposition of boron from BBr_3. Best results were obtained with boron and tantalum filaments. Boron crystal deposits 2 cm in diameter and 15 cm in length were deposited on small, vertical boron filaments. (auth)

7830 GROWTH OF BORON CRYSTALS BY THE CZOCHRALSKI AND FLOATING-ZONE METHODS. R. J. Starks and W. E. Medcalf (Eagle-Picher Research Labs., Miami, Okla.). p.59-69 of "Proceedings of the Conference on Boron."

An investigation was made of various ways to densify and grow crystals of boron. Induction heating methods were used to densify the boron in boron nitride crucibles and on pedestals of boron and boron nitride. Crystals approximately 6 in. in length were grown by the Czochralski method from densified charges. Floating-zone studies were carried out on bars prepared by the Czochralski growth process from boron nitride crucibles and crystal bars as deposited in the vapor phase deposition. Five zone passes were normally made, with the liquid zone moving from the top to the bottom of the vertical ingot. The zoned bars grown from boron nitride crucibles by the Czochralski process tended to crack with zoning after one or two zone passes. Spectrographic analysis of the zoned bars showed that Si, Fe, Cu, V, and Ca concentrated in the bottom end of the zoned bar, indicating that these impurities had segregation coefficients less than unity. The concentration of magnesium decreased toward the lower end of the bar. Electrical measurements made on the zoned bars showed that the resistivity ranged from 10^7 to 10^4 ohm-cm, decreasing toward the bottom portion of the bar. Small monocrystalline areas were found in the float-zoned bars which x-ray studies showed to be of the rhombohedral structure. Comparison is made of properties of the bars zoned in vacuum and ambient gases. (auth)

7831 ZONE PURIFICATION OF BORON. F. Hubbard Horn (General Electric Research Lab., Schenectady, N. Y.). p.70-3 of "Proceedings of the Conference on Boron."

Boron was zone-refined using boron nitride boats. Segregation coefficients for a number of impurities are given in qualitative terms. Crystalline boron was grown by the Czochralski method. Some electrical, optical, and thermal data are discussed. (auth)

7832 CRYSTALLOGRAPHY OF THE ALUMINUM BORIDES. J. A. Kohn (U. S. Army Signal Research and Development Lab., Fort Monmouth, N. J.). p.75-82 of "Proceedings of the Conference on Boron."

At present, there are five authenticated phases in the aluminum–boron system: (1) AlB_2–hexagonal; bronze-colored, thin platelets; (2) AlB_{10}–orthorhombic, black lustrous, pyramidal and tabular; new phase; (3) alpha-AlB_{12}–tetragonal, pseudocubic; hematite-like plates and laths (irregular pseudooctahedra); thin sections orange-red in strong transmitted light; (4) beta-AlB_{12}–orthorhombic, pseudotetragonal; amber-colored, bipyramidal; polysynthetically twinned on (110) and ($1\bar{1}0$); and (5) gamma-AlB_{12}–orthorhombic, polytypically related to alpha-AlB_{12}; hematite-like, orthogonal laths; new phase. The first is the only aluminum boride phase whose properties are different from those of boron and also the only phase whose structure is known. The last three have common unit cell vectors which show that, as in boron carbide and the known forms of boron, boron icosahedra represent the major structural elements. (auth)

7833 A NEW MODIFICATION OF ELEMENTAL BORON. C. P. Talley (Experiment Inc., Richmond), B. Post and S. LaPlaca. p.83-5 of "Proceedings of the Conference on Boron."

A new modification of elementary boron was prepared by the decomposition of purified BBr_3 on hot tungsten and rhenium filaments at various temperatures close to 1200°C. The unit cell is tetragonal; cell dimensions are: a = 10.12A, c = 14.14A. The measured density is 2.364 ± 0.005 g/cm^3, indicating that the unit cell contains 192 boron atoms, possibly arranged at the vertices of 16 icosahedra. Work with this phase indicates that the modification is metastable; when melted and subsequently cooled the tetragonal form was found to transform to the rhombohedral modification recently reported. (auth)

7834 SOME NEW RARE EARTH BORIDES. I. Binder (Firth Sterling, Inc., Yonkers, N. Y.), S. LaPlaca, and B. Post. p.86-93 of "Proceedings of the Conference on Boron."

Reaction of rare earth (and yttrium) metal oxides with boron, in the proper proportion, at elevated temperatures, yielded a previously unreported series of binary rare earth (and yttrium) borides corresponding to the formula MB_{12}. The MB_{12} preparation is isostructural with the previously reported UB_{12} and ZrB_{12}. The unit cell is face-centered cubic with four formula weights per unit cell. Details of lattice constants and structures are discussed. (auth)

7835 PREPARATION AND PROPERTIES OF MASSIVE AMORPHOUS ELEMENTAL BORON. Claude P. Talley, Lloyd E. Line, Jr., and Quinton D. Overman, Jr. (Experiment Inc., Richmond). p.94-104 of "Proceedings of the Conference on Boron."

Massive amorphous elemental boron was prepared by the reduction of BBr_3 vapor by H_2 in the vicinity of an incandescent tungsten filament 25 μ in diameter. Information on the kinetics of the process was obtained. Conditions were developed for obtaining the boron in the shape of rods up to 2 mm in diameter and 5 to 10 cm in length. Boron deposits in the shape of spheres, hemi-

spheres, and cones were also observed. Wet chemical analysis of a 1-mm dia. rod for total boron indicated a boron content of approximately 99% by weight. Rods of amorphous boron showed high tensile strength and Young's modulus (2.3×10^5 to 3.5×10^5 lb/in.^{2} and 64×10^6 lb/in.^{2}, respectively). The density was determined by a flotation technique and found to be 2.354 ± 0.005 gm/cm^3. This material is very hard, as evidenced by its ability to scratch sapphire, and exhibits a relatively high resistivity and high negative temperature coefficient of electrical resistance, a characteristic of crystalline boron and semiconductors in general. It also is very opaque in the visible but can be crystallized by proper heat-treatment into other modifications, including one which transmits a considerable amount of red light. (auth)

7836 THE FLOATING-ZONE MELTING OF BORON AND THE PROPERTIES OF BORON AND ITS ALLOYS. Earl S. Greiner (Bell Telephone Labs., Inc., Murray Hill, N. J.). p.105-9 of "Proceedings of the Conference on Boron."

Pressed powder compacts of crystalline boron, suitable for floating-zone melting, have been prepared by using boron trioxide as a binder. The zone-melted boron was coarsely polycrystalline and some crystals were twinned. The structure was rhombohedral with 107 or 108 atoms per unit cell. The electrical resistivities of zone-melted boron and vapor-deposited boron were identical in the intrinsic conductivity range and nearly the same in the extrinsic conductivity range. Increasing the amount of phosphorus in boron decreases the resistivity at low temperatures or where extrinsic conductivity predominates. The compound BP can be prepared by the reduction of BCl_3 and PCl_3 with hydrogen at 900 to 1000°C. (auth)

7837 SIMPLE RHOMBOHEDRAL BORON—PREPARATION AND PROPERTIES. F. H. Horn (General Electric Research Lab., Schenectady, N. Y.). p.110-15 of "Proceedings of the Conference on Boron."

An allotrope of boron in a simple rhombohedral crystal structure has been reported. Salient features of boron in this structure are reviewed. Simple rhombohedral boron was crystallized from platinum melts. The necessary conditions are indicated. Some preliminary electrical and optical results for boron in the simple rhombohedral form are discussed and compared with results for boron that has been melted. (auth)

7838 OBSERVATIONS ON BORON AND SOME BORIDES. W. R. Eubank, L. E. Pruitt, and H. Thurnauer (Minnesota Mining and Mfg. Co., St. Paul). p.116-27 of "Proceedings of the Conference on Boron."

Single crystals of beta-rhombohedral boron were grown in both needle and plate habit from the vapor phase. Maximum size of needle crystals was approximately 5 mm × 0.1 mm × 0.1 mm. Penetration twinning and growth steps at one end of a crystal were detected in some cases. These boron needles were characterized by smooth lateral faces of high reflectivity. Thin lathlike red crystals of AlB_{12} were prepared from the elements at reduced pressure. Dense polycrystalline structures of boron, silicon hexaboride, and strontium hexaboride were prepared by vacuum hot-pressing finely divided powders. Microstructure was studied microscopically with reflected light after diamond polishing and etching. Change in resistance with temperature was measured for both the mono- and polycrystalline material. Energy gap and intrinsic conductivity determinations from log R vs. 1/T curves indicate that boron prepared by the vacuum process is of higher purity than commercially available boron and of as high a purity as that prepared experimentally by other workers. (auth)

7839 SEMICONDUCTOR PROPERTIES OF BORON. A. K. Hagenlocher (Telefunken, Ulm, Germany). p.128-34 of "Proceedings of the Conference on Boron."

Crystalline boron was grown on a hot tantalum filament in a boron tribromide atmosphere. After removal of the filament, the material was treated by a modified floating-zone process. Silicon is the prevalent impurity in the end product, which was polycrystalline and had large crystallites. The resistivity of purest material was 4×10^6 ohm-cm at room temperature, and 5×10^{-2} ohm-cm at 1950°C; the intrinsic ionization energy was 1.5 ev. Doped material was also investigated; the ionization energies were 0.6 ev for beryllium, 0.7 ev for carbon, and 0.5 ev for silicon. As expected, doping with beryllium led to p-type, and doping with silicon or carbon, to n-type boron. Low ionization energies found in some highly doped samples suggest the formation of impurity bands when the concentrations exceed approximately 5×10^{16} cm^{-3}. The Hall mobilities were 55 cm^2/v/sec for holes and 1 cm^2/v/sec for electrons at room temperature. Temperature dependence of mobility is also discussed. Results are compared to those reported by other authors. (auth)

7840 SOME ETCHING STUDIES ON BORON. Ray C. Ellis, Jr. (Raytheon Co., Waltham, Mass.). p.135-9 of "Boron: Synthesis, Structure, and Properties. Proceedings of the Conference on Boron." New York, Plenum Press, Inc. 1960.

Samples of crystalline boron were polished and reacted with H_2SO_4 at 300°C, boiling HNO_3, NaOH-50 wt.% KNO_3 at 400°C, and $Na_2B_4O_7$-50 wt.% KNO_3 at 620°C and the microstructures were studied. Carbonate-containing etches were also tested and found to leave a black graphite deposit on the boron surface, while sulfate-containing etches analyzed after reaction with boron were found to contain polysulfide; both effects were probably due to reduction by boron. In fused salt etches, if the mixture overheats, the boron sample tends to be consumed with incandescence. (D.L.C.)

7841 VECTOR HARDNESS PROPERTIES OF BORON AND ALUMINIUM BORIDES. A. A. Giardini, J. A. Kohn, L. Thoman, and D. W. Eckart (U. S. Army Signal Research and Development Lab., Fort Monmouth, N. J.). p.140-58 of "Proceedings of the Conference on Boron."

The results of a detailed investigation on the vector hardness properties of the aluminum—boron system are reported. The experimental method used was that of Knoop-type microindentations. Data are presented for the (10.1) plane of boron the (110), (101), and (221) planes of alpha-AlB_{12}, the (100-010), (101-011), and (201-021) planes of beta-AlB_{12}, the (100) plane of gamma-AlB_{12}, the (010), (101), and (111) planes of AlB_{10}, the (00.1) plane of AlB_2, and also for polycrystalline aluminum and boron. AlB_{10} was found to possess both the greatest magnitude of microindentation hardness and the greatest anisotropy in the materials studied. A hardness phase diagram, crystallographic and vector azimuth illustrations, and data tables are included. (auth)

7842 OPTICAL AND ELECTRICAL PROPERTIES OF BORON AND POTENTIAL APPLICATION. G. K. Gaulé, J. T. Breslin, J. R. Pastore, and R. A. Shuttleworth (U. S. Army Signal Research and Development Lab., Fort Monmouth, N. J.). p.159-74 of "Proceedings of the Conference on Boron."

The boron used in the investigation was of the beta

rhombohedral form and was usually mosaic. For the electric properties, the resistivity was found to be in the megohm-cm range and the Seebeck coefficient was ~500 μv/°C, but rectification and the photovoltaic effect were not observed. For the optical properties, the variation among the infrared absorption spectra was much larger than for the electric properties; the material could be grouped into four classes according to the spectra. A rather unusual magnetic effect was found in one of these classes in that magnetic pulses induced a decrease of resistivity. The effects of impurities on the properties of boron and the possible applications of boron as a semiconductor material are discussed. Several thermistors using boron were constructed and their performance studied. (D.L.C.)

7843 OXIDATION OF BORON AT TEMPERATURES BETWEEN 400 AND 1300°C IN AIR. Harry F. Rizzo (Aeronautical Research Lab., Wright-Patterson AFB, Ohio). p.175-89 of "Proceedings of the Conference on Boron."

The oxidation behavior of powder compacts of both amorphous and crystalline boron was studied in air at temperatures between 400 and 1300°C. Crystalline and amorphous boron during the initial stage of oxidation followed a parabolic rate law. Crystalline boron formed a protective coating of boron oxide between 600 and 1100°C, and after 24 hours in this temperature range 16 to 19% of the boron was oxidized to B_2O_3. Amorphous boron oxidized at a greater rate than crystalline boron between 600 and 1000°C, and after 24 hours 22 to 26% of the boron was oxidized to B_2O_3. Above 1000°C vaporization of B_2O_3 took place, in addition to the formation of a brown suboxide of boron. The composition of this suboxide has been determined as B_7O. Boron nitride was also formed during the oxidation of amorphous boron between 1100 and 1300°C. In addition to the oxidation of powder compacts of boron, a number of oxidation tests were performed with crystalline boron in the massive form. There is considerable scatter of the data for boron in the massive form which is attributed to microcracks in the boron. The addition of silicon was found to increase substantiallv the oxidation resistance of boron. (auth)

7844 IMPROVEMENTS IN ZIRCONIUM ALLOYS. Geoffrey Charles Edward Olds and John Edwin Harris (to British Thomson-Houston Co., Ltd.). British Patent 857,835. Jan. 4, 1961.

A Zr–Nb–Cu alloy containing 2 to 7 wt.% niobium, 0.25 to 3 wt.% copper, and balance zirconium was found to have increased strength over Zr–Cu alloys. The corrosion resistance and low neutron absorption cross section were unchanged. Creep tests were made with stresses of 6000 psi at 500°C for 500 hr; the creep strain of Zr–5% Nb–1% Cu alloy was ~¼ of that of Zr–1% Cu alloy. (D.L.C.)

7845 NEUTRONIC REACTOR FUEL COMPOSITION. W. C. Thurber (to U. S. Atomic Energy Commission). U. S. Patent 2,967,812. Jan. 10, 1961.

Uranium–aluminum alloys in which boron is homogeneously dispersed by adding it as a nickel boride are described. These compositions have particular utility as fuels for neutronic reactors, boron being present as a burnable poison.

Radiation Effects

7846 (AERE-M-545) EFFECT OF ELECTRON IRRADIATION ON AN ARYL-TRIAROXY-SILICON HEAT TRANSFER FLUID. R. W. Wilkinson (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Nov. 1960. 9p.

An aryl-triaroxy silicon heat-transfer fluid was electron-irradiated at 300 to 400°C and the resulting gaseous, liquid, and polymeric products determined. The viscosity changes also were measured using a sealed suspended-level type viscometer. It was found that while the decomposition yields are satisfactorily small, the viscosity increase is very great, especially at high doses. Some information about the structure of the polymeric material produced was obtained from infrared spectra. (auth)

7847 (BMI-1491) THE EFFECT OF HIGH-BURNUP IRRADIATION ON MASSIVE URANIUM MONOCARBIDE. Alan W. Hare and Frank A. Rough (Battelle Memorial Inst., Columbus, Ohio). Jan. 6, 1961. 27p. Contract W-7405-eng-92.

The results of examinations of uranium carbide having a nominal composition of uranium-5 wt.% carbon are very encouraging after irradiation to a burn-up of about 25,000 Mwd/ton of uranium. The density changes were relatively small, 3.4 and 4.4% for the two specimens that were irradiated. Dimensional changes were correspondingly small with increases in the diametral direction of only 1.2 and 1.4%. Only one large crack was observed in one of the specimens immediately upon removal from the test capsule. A metallographic examination showed that the microstructure of the fuel did change noticeably during the irradiation. (auth)

7848 (CRMet-963) THE EFFECT OF NEUTRON IRRADIATION ON PRECIPITATION HARDENING IN COPPER–BERYLLIUM ALLOYS. C. R. Cupp (Atomic Energy of Canada Ltd., Chalk River, Ont.). Aug. 1960. 23p. (AECL-1139).

Copper–2.10 wt. % beryllium alloy specimens were hardness tested at intervals during aging at 300 or 325°C following solution annealing, solution annealing and neutron irradiation at 50°C, solution annealing and 35% cold reduction, and solution annealing and aging at 150°C. Effects of neutron irradiation were noted, and possible mechanisms were suggested for a marked hardness increase on irradiation. These mechanisms are consistent with a retrogression that was observed in postirradiation aging. Following the retrogression, a radiation-enhanced precipitate nucleation occurred which caused more rapid than normal hardening. In the final stages of hardening, a higher maximum hardness was reached after longer aging times in irradiated samples compared with unirradiated control specimens. Changes in the microstructure of solution-treated specimens were observed after irradiation. These effects were apparently due to radiation-induced compositional changes. (auth)

7849 (NAA-SR-Memo-5306) OXIDE COMPOSITION AFTER SECOND IRRADIATION CYCLE. R. D. Kessinger (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). May 26, 1960. 61p.

A study was made of a proposed fuel cycle for uranium dioxide. The cycle will include irradiation, processing, and reirradiation. An estimate of the composition of the oxide after the second irradiation was made. The fuel is 8% enriched and the flux is 2×10^{13} nv. A MTR cycle is defined as 21 days, 70% at full power and 30% at zero power. The programs to which the fuel will be subjected are the following: 5 MTR cycles, 3 yr cooling, processing, and 10 MTR cycles and 10 MTR cycles, 2 yr cooling, processing, and 10 MTR cycles. (W.L.H.)

7850 (NAA-SR-Memo-5824) TEST RESULTS—RARE EARTH OXIDE IRRADIATION (NAA-110 EXPERIMENT). T. E. Redding (Atomics International. Div. of North American Aviation Inc., Canoga Park, Calif.). Oct. 25, 1960. 24p.

A long-term irradiation test of the rare-earth oxide materials proposed for use as neutron absorber materials in the HNPF was conducted to establish the radiation stability of these materials with regard to dimensional, chemical, and thermal characteristics. The materials were exposed to approximately 5.0×10^{20} nvt at the surface of the experiment. Results of the test indicate that no appreciable dimensional changes occurred during the test, the apparent thermal conductivity of the mixed oxides (45% Gd_2O_3–45% Sm_2O_3) remained constant at 1.0 to 1.20 Btu/hr/ft/°F, and the apparent thermal conductivity of the 90% Gd_2O_3 remained essentially constant at 1.3 to 1.4 Btu/hr/sq ft/°F/ft. Heat generation rates in the poison materials also remained constant at about 1.30 kw/ft-10^{13} nv in the mixed oxides and about 1.4 kw/ft-10^{13} nv in the 90% Gd_2O_3. (auth)

7851 (NP-9750) EFFECT OF NUCLEAR RADIATION ON MATERIALS AT CRYOGENIC TEMPERATURES. Progress Report No. 1 [for] December 1959 through September 1960. (Lockheed Nuclear Products, Marietta, Ga.). 420p. Contract NASw-114. (NR-115)

Activities in a program to evaluate the mechanical characteristics of structural materials, problems related to fabricability, and evaluation of components for nuclear space vehicles are described. The program is divided into correlation testing, screen testing, and final material evaluation phases. Completed correlation tests are reported on titanium and aluminum alloys. Screening tests for selection of materials are based on evaluation of existing technical data provided by recognized specialists in the fields of radiation effects, structure, and metallurgy. Materials selected for testing include aluminum, nickel, and titanium alloys, and stainless steel. Specimen preparation is described. Plans and designs related to fabrication of test loops, instrumentation and shields, refrigeration systems, special handling equipment and facilities, and modifications to the Plum Brook Reactor, required for execution of the program, are described. (J.R.D.)

7852 (SCTM-404-60(14)) RADIATION TOLERANCE OF A SELECT GROUP OF SEMICONDUCTOR DIODES. C. I. Westmark (Sandia Corp., Albuquerque, N. Mex.). Nov. 23, 1960. 14p.

A select group of reference type silicon diodes were irradiated through an integrated flux range from 10^{13} to 7×10^{16} nvt (E>kev). Parameters that would indicate displacement damage were monitored during the irradiation. A brief presentation is given which shows the qualitative nature of findings, and recommendations are made on how quantitative results could be obtained in the future. (auth)

7853 (TID-11502) RADIATION EXPANSION AND THERMAL EXPANSION IN X-RAYED ROCKSALT. Marshal Fredric Merriam (Carnegie Inst. of Tech., Pittsburgh). Nov. 1960. 160p. Contract AT-(30-1)-1828.

The volume expansion of NaCl heavily irradiated at room temperature with penetrating x rays was studied with a photoelastic technique. In the course of the study a new effect was found: the coefficient of thermal expansion of NaCl is increased by irradiation. The magnitude of the fractional increase in expansion coefficient is about fourteen times the concentration of radiation induced defects, as measured by the volume expansion. Typically, this increase is a fraction of 1 per cent. Its algebraic sign and approximate magnitude is predicted on general thermodynamic grounds. The increase in expansion coefficient seems to be correlated only with the total concentration of point lattice defects, and is rather insensitive to their electronic state or spatial distribution. The growth and annealing of the volume expansion have been measured, and correlated with the growth and annealing of the optical absorption. The volume expansion increases linearly with time for short irradiation times at a rate consistent with that implied by the F center growth curve on the basis of Mitchell's interpretation. The annealing of the volume expansion and optical absorption is in general agreement with the earlier results of Kobayashi. Interpretation of the annealing data is difficult if the Varley mechanism of vacancy generation is assumed. There is some evidence that the initial annealing of the volume expansion is limited by diffusion of negative ion vacancies. An interesting surface feature, apparently connected with the radiation, was observed on several samples. (auth)

7854 IRRADIATION HARDENING IN COPPER AND NICKEL. M. J. Makin and F. J. Minter (Atomic Energy Research Establishment, Harwell, Berks, England). Acta Met. 8, 691-9(1960) Oct.

The lattice and dislocation components of irradiation hardening were measured in polycrystalline copper and nickel as a function of testing temperature and neutron dose. The results are compared with Seeger's theory of lattice hardening, which is based on dislocations cutting through a forest of obstacles under the action of stress and thermal activation. The observed temperature dependence of the lattice hardening in both metals is in excellent agreement with the theory in the as-irradiated condition. Mild annealing treatments greatly reduce the temperature sensitivity, and the theory is no longer obeyed. From the results it is concluded that the obstacles do not have a constant activation energy as assumed by Seeger, and theories of the temperature dependence should include this factor. It is shown that the dose dependence of lattice hardening may be described by the formula $\sigma_i = A(1 - e^{-B\phi})^{1/2}$, which is derived by combining the theoretically predicted dependence on $\phi^{1/2}$ with a saturation effect. The existence of obstacles of various sizes is indicated from measurements of temperature dependence of the constants in the equation. No definite conclusions as to the mechanism of formation of the obstacles can be made at present. The dislocation hardening component is shown to be independent of testing temperature in copper, but not in nickel. (auth)

7855 GAMMA RADIATION EFFECTS ON SEIGNETTOELECTRIC PROPERTIES OF TRIGLYCINESULFATE CRYSTALS. V. A. Yurin, A. S. Baberkin, E. N. Kornienko, and I. V. Gavrilova (Inst. of Crystallography, Academy of Sciences, USSR). Izvest. Akad. Nauk S.S.S.R., Ser. Fiz., 24, 1334-6(1960) Nov. (In Russian)

The influence of γ radiation on the seignettoelectric properties of triglycinesulfate was studied at a dose rate of 235 r/sec. It was found that γ radiation forms a strong polydomain state (double hysteresis loop) or stable monodomain state (shifted hysteresis loop). A domain structure stability results from the formation of "intrinsic displacement fields." In polydomain specimens the "intrinsic displacements" in the neighboring antiparallel domain are reversed and in monodomain specimens they are the same. (R.V.J.)

7856 DEGRADATION OF COTTON IN AN OXYGEN ATMOSPHERE BY GAMMA RADIATION. Florine A.

Blouin and Jett C. Arthur, Jr. (Southern Regional Research Lab., New Orleans, La.). J. Chem. Eng. Data 5, 470-5 (1960) Oct.

To determine the mechanism of the radiation-induced reactions of cellulose and to evaluate these chemical alterations of the cellulose molecule with relation to the production of new cotton products, the specific chemical nature of the oxidized groups formed must be known. Even though previous work indicated that only small differences in properties were produced, the atmosphere under which the irradiation was carried out is very important in respect to the exact chemical nature of the groups produced. Investigations of the specific nature of the groups formed on cotton cellulose in an atmosphere of oxygen at a γ radiation dose of 10^6 r are reported. The penetrating power of γ-rays, and probably most other kinds of high energy radiation, makes the oxidative degradation of the cellulose molecule unique when compared to ordinary chemical oxidations. The ionizations induced in cellulose are not hindered by the crystalline-amorphous nature of the cellulose structure. The γ irradiation of cellulose produces chain cleavage, reducing groups and acid groups. The chain cleavage ratio for this work was found to be 19 : 0.5 : 1 as compared to 20 : 1 : 1 found by Arthur and Blouin. The distribution of acid groups between the various fractions of the irradiated cellulose indicated that acid group production was principally a chain-end effect and that one acid group was produced per every two chains formed. The data suggested that activation of the C_2, C_3, C_5, and C_6 positions of the polymer caused reducing group formation with evolution of hydrogen and without chain cleavage. The carbon monoxide and carbon dioxide evolved in the irradiation are considered to be secondary degradation products from aldehydes and/or ketones for CO and decarboxylation of carboxyl groups in the case of CO_2. (B.O.G.)

7857 RADIATION DAMAGE IN GRAPHITE. G. E. Bacon (Atomic Energy Research Establishment, Harwell, Berks, England). J. chim. phys. 57, 828-36(1960) Oct. (In English)

During irradiation by neutrons, the atoms of carbon are displaced from their normal positions in the tridimensional structure, which causes the appearance of vacant sites and interstitial atoms. The carbon layers are forced apart and the increase of the separation between the layers, which can be measured with x rays, gives a good indication of the damage caused by the radiation. At 30°C this spacing can increase approximately 16% before saturation starts, but when the irradiation temperature is increased, the increase of c is much weaker and saturation begins much sooner, below 1% at 500°C. In connection with the increase of c, there are important modifications in the volume density, the stored energy, the thermal conductivity, and other physical properties. The damage can be removed by a thermal anneal outside the reactor or, more simply, by an irradiation anneal at a lower temperature than the other anneal. The precise nature of the faults produced by irradiation is not known, but it appears that according to the increase of the degree of damage, the types of faults are more and more complex. It is difficult to explain in detail the relation between the variation of the crystallographic unit cell and the modifications of the dimensions of macroscopic blocks of graphite. At low temperatures there is a complete increase of the volume of the block with the irradiation, but, at much higher temperatures, there is a reduction of the volume. This perhaps corresponds to the fact that the radiations cause a diffusion to the edge of the crystallites allowing a reduction of the volume density. (tr-auth)

7858 THE MICROHARDNESS OF COPPER BOMBARDED WITH ALPHA-PARTICLES. T. K. Ghosh, C. J. Beevers, and R. S. Barnes (Atomic Energy Research Establishment, Harwell, Berks, Eng.). J. Inst. Metals 89, 125-7(1960) Dec. (AERE-R-3235).

The hardness induced in copper after bombardment with 38-Mev α-particles was investigated, together with its annealing characteristics. The hardening can be separated into two parts: (i) that caused by atomic displacements, produced by the passage of the energetic α-particles; and (ii) that at the end of the α-particle track, caused by the deposition there of the helium atoms. The former hardness anneals at 300°C and the latter only when the helium atoms collect into observable bubbles. (auth)

7859 ENERGY CONSIDERATIONS FOR PRODUCTION OF RADIATION DEFECTS. M. Balarin and O. Hauser (Zentralinstitut fur Kernphysik, Rossendorf, Ger.). Kernenergie 3, 973-8(1960) Oct.-Nov. (In German)

It is shown that in reactor neutron irradiation all collisions between primary knock-on atoms and other atoms of the same solid can be treated as collisions between hard spheres using classical mechanics. Instead of the often used relation for the number of knocked-out atoms $n = E_0/2E_d$, one obtains $n = E_0/5E_d$. Thereby it was considered that not all collisions produce displacements and that for each displacement collision an energy E_d is required. But from this energy principle the number of possible displacements in present theories is reduced by a factor of about 2.5. (auth)

7860 CHANGES IN THE INSULATION RESISTANCE OF POLYSTYRENE UNDER THE EFFECTS OF REACTOR RADIATION. O. Hauser, L. Heyne, and H. Höfgen (Zentralinstitut für Kernphysik, [Rossendorf, Ger.]). Kernenergie 3, 1072-4(1960) Oct.-Nov. (In German)

Polystyrene was chosen for the study of reactor radiation effects on the electric properties of reactor materials. A field strength of 6 kv/cm was used, and a γ dose of 4.5×10^3 r/hr was applied in a fast neutron flux of 2.2×10^8 and a thermal neutron flux of 2.3×10^8 cm^2/sec. Curves are given showing resistance before, during, and after radiation. (T.R.H.)

7861 RADIATION-INDUCED DEFECTS IN LEAD SILICATE GLASS. R. S. Barker, D. A. Richardson, E. A. G. McConkey, and R. E. Yeadon (Pilkington Brothers, Ltd., St. Helens, Lancs, Eng.). Nature 188, 1181(1960) Dec. 31.

Exposure of irradiated glass to light at room temperature produces bleaching of the color centers by excitation of the trapped electrons to such energy levels as to enable them to escape from the defects and recombine with the positive holes. It might be expected that such treatment should release the trapped electrons but have little effect on the total number of defects. Hence such a bleached sample of glass should contain a greater concentration of defects or trapping centers than an unirradiated sample and, on further irradiation, should contain more color centers than an originally unirradiated sample which is subjected to a first irradiation. To test this theory a sample of the lead silicate glass used in experiments described previously was given a dose of 10^6 rads of γ radiation and its optical density was measured over the wavelength range 360 to 1,000 mμ at intervals of time during the week following the irradiation. The induced coloration was then bleached by exposure to light from a mercury lamp until the optical density of the glass was not significantly different from that measured before the irradiation. The sample was then given a further dose of 10^6 rads, and the

optical absorption was again measured. Data are presented on the variation in optical density with time for four wavelengths after the first and second irradiations. It can be seen that the optical density of the sample after bleaching and reirradiation is at all times greater than that obtained after the first irradiation. This result is in accord with the proposed theory. (auth)

7862 THE EFFECT OF LATTICE DISTORTION AROUND POINT DEFECTS ON THE SCATTERING OF LONG WAVELENGTH NEUTRONS. D. G. Martin (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Phil. Mag. (8) 5, 1235-46(1960) Dec. (AERE-R-3341).

In a crystalline element the scattering of long wavelength neutrons by a point defect and an atom are known to be identical. However, when lattice distortion around the point defect is also considered, this is no longer true; in particular, the scattering of a point defect is anisotropic and varies with wavelength. An expression for the cross section of a defect in a relaxed lattice was derived and applied to fcc and bcc lattices and in greater detail to copper and molybdenum where the magnitude of the relaxation around defects is known. It was found that the scattering cross section is appreciably altered by the relaxation of the surrounding atoms and, in particular, from those that are nearest neighbors to the defect. A neglect of this relaxation in the interpretation of a neutron-scattering experiment could lead to an error of an order of magnitude in an estimate of the number of defects. Also a study of the variation in cross section with wavelength or scattering angle, which is analogous to an x ray small-angle-scattering experiment, is incapable of determining uniquely the size of defect agglomerates in solids. However, under favorable circumstances, such experiments could become a useful technique for estimating the lattice distortion around defects. (auth)

7863 THE NATURE OF RADIATION-INDUCED POINT DEFECT CLUSTERS. R. S. Barnes and D. J. Mazey (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Phil. Mag. (8) 5, 1247-53(1960) Dec. (AERE-R-3348).

The electron microscope was used to examine point defect clusters produced in copper and aluminum foils bombarded with 1.4×10^{17} α-particles cm^{-2}. The foils were bombarded as a stack; and, in copper, both foils through which the α-particles had passed and that in which they came to rest appeared similar, containing dislocation loops ($r \sim 200$ A) and a background of more numerous and smaller dots ($r \sim 20$ A). The behavior at grain boundaries suggested that these two types of cluster were caused by different point defects. Whereas the dislocation loops normally annealed out at about 350°C, in the foil in which the α-particles came to rest (containing $\sim 10^{15}$ atoms of helium cm^{-2}) they grew to form a dislocation tangle, and eventually small helium bubbles ($r \sim 40$ A) appeared in the same number as the original small dots. The results indicate that the dislocation loops are caused by the clustering of interstitial atoms and the small dots are clusters formed from vacancies. It is inferred that the helium atoms are in interstitial positions during the bombardment and form bubbles by nucleating upon the clusters. (auth)

7864 ACTIVATION OF SINGLE PHONON INFRA-RED LATTICE ABSORPTION IN NEUTRON IRRADIATED DIAMOND. S. D. Smith and J. R. Hardy (Univ. of Reading, Eng.). Phil. Mag. (8) 5, 1311-14(1960) Dec.

The activation of a band in the absorption spectrum of a type IIa diamond was accomplished using fast neutrons. The absorption spectra taken before and after a dose of $3 \times 10^{17}/cm^2$ are shown. Strong continuous absorption is evidenced following irradiation, beginning sharply at the Raman energy and extending to lower frequencies. This effect can only be explained satisfactorily as single phonon lattice absorption. It is suggested that most of the damage-induced activation arises from regions of local disorder which probably involve more than 10^{20} atoms/cm^3. It is concluded that absorption activation in the one phonon region by damage strongly supports the theory that it is caused by defect induced coupling to the fundamental lattice modes. (B.O.G.)

7865 RESOLVED HYPERFINE SPECTRA OF ELECTRON-SPIN PARAMAGNETIC RESONANCE IN IRRADIATED LiF. Y. W. Kim, R. Kaplan, and P. J. Bray (Brown Univ., Providence). Phys. Rev. Letters 6, 4-6 (1961) Jan. 1.

Evidence is presented for the view that the hyperfine structure observed in the ESPR spectra of irradiated LiF cannot be ascribed simply to the presence of F centers in the crystal. The evidence was obtained from LiF crystals exposed at room temperature to 40-kv x rays, thermal neutrons, or γ rays of varying doses. The hyperfine spectra were taken at 77 or 300°K and differ from those of Holton et al. Two different spectral shapes were observed, one Gaussian for samples irradiated with x rays, γ rays, and neutrons up to a dose of 10^{18} nvt and the other Lorentzian for some samples with neutron doses $\geq 10^{16}$ nvt. The anisotropy of the spectra was studied by rotating the sample about its [1 1 0] axis. Heat treatment was found to change some Gaussian-shaped spectra into Lorentzian or other shapes. A possible mechanism to explain these results is given in which two types of paramagnetic centers are formed, the first responsible for the anisotropic hyperfine structure and the second easily affected by thermal treatments. The data suggest that the second type is a F center and accounts for the Gaussian-shaped spectra. (D.L.C.)

7866 RADIATION STABILITY OF THE KU-2 RESIN IN VARIOUS IONIC FORMS. A. M. Semushkin and I. A. Kuzin (Leningrad Inst. of Tech.). Zhur. Priklad. Khim. 33, 2323-9(1960) Oct. (In Russian)

It has been previously established that the radiation resistance of ion exchange resins is primarily a function of their structure. Sulfo-cathionites, such as the KU-2 type resin containing benzene rings, were found to be most resistant. As a result of studies on the influence of sorbed ions on the behavior of KU-2 resin exposed to radiations ranging from 0.76 to 8.5×10^8 r from a Co^{60} γ source, it was established that the physico-chemical properties of the irradiated resin are strongly affected by the sorbed ions. When irradiated in its hydrogen-containing form, the absorbing ability of the resin is decreased while the reducibility and the ability to form hydrates is increased, indicating that the primary effect of the radiation consists in the destruction of the polymer. The behavior of the resin saturated with alkali and alkaline-earth ions is very similar. Certain sorbed ions with variable valencies exert a stabilizing influence. The sorption and desorption of radioactive isotopes appears to be radically different from the ion-exchange phenomena of the stable isotopes; this question is being further studied. (TTT)

7867 RADIATION RESISTANT ELASTOMERIC ARTICLES. (to The Goodyear Tire & Rubber Co.). British Patent 853,219. Nov. 2, 1960.

The radiation resistance of pneumatic tires for nuclear-powered vehicles may be improved without changing fabrication methods by first flushing their interior with an inert gas and then inflating with nitrogen or helium.

The reason for the increased radiation resistance is that the inert gas diffuses into the tire to displace the oxygen and thus prevents tire degradation due to oxidation. (D.L.C.)

7868 PROCESS FOR INCREASING THE ELONGATION OF IRRADIATED LINEAR RESINOUS PLASTIC MATERIALS. (to Sequoia Process Corp.). British Patent 855,874. Dec. 7, 1960.

A method for increasing the elongation of linear polyethylene is outlined in which a small amount of a substance selected from rubber accelerators and vulcanizing agents containing one of the elements sulfur, selenium, or tellurium and a sulfonyl hydrazide is incorporated into the polymer, and the resulting mixture is exposed to high-energy ionizing radiation to a dose of 10^6 to 10^8 rep and then heated to 140 to 160°C for ½ to 1 hr. This method is illustrated by an example in which an insulated wire is prepared, and tables are presented showing the effects of oven aging time and irradiation dosage on the properties of irradiated Marlex. (D.L.C.)

PHYSICS

General and Miscellaneous

7869 (AEDC-TN-60-192) THE EQUATION OF STATE OF AN IONIZED GAS. Donald P. Duclos (Northwestern Univ., Evanston, Ill. Gas Dynamics Lab.). Oct. 1960. 153p. Contract AF40(600)-748. (AD-244319).

An investigation was made to determine the thermal and caloric equations of state of an ionized gas. The investigation is restricted to an ionized gas which is in thermal equilibrium and electrically neutral. It is further restricted to the range of temperature and electron densities which might possibly occur in engineering applications. Only monatomic ionized gases are considered. (W.L.H.)

7870 (AFOSR-TN-60-906) PRODUCTION OF A MOLECULAR BEAM AT A VERY HIGH SPEED AND RELATIVELY GREAT DENSITY—REALIZATION OF A MOLECULAR GUN. F. Marcel Devienne and J. Souquet (Laboratoire Mediterraneen de Recherches Thermodynamiques, Nice). June 1960. 41p. Contract AF61(052)296. (AD-244407)

An effort was made to obtain molecular beams with intensities exceeding 10^{18} molecules/cm^2/sec, with speeds ranging between 10 and 30 km/sec or higher. In order to have such a molecular beam, the charge or momentum exchange is produced between ions and a molecular beam. A cylindrical ionic beam is obtained by the high-frequency ionization of a molecular beam coming from a hypersonic nozzle. This beam passes through a quartz tube around which a coil is wound. A high-frequency current flows through the coil. The ionization efficiency exceeds 10%. The ions are separated from the molecules by means of a magnetic field generated by an electromagnet. Then, the ion beam is accelerated and brought to the satisfactory voltage by a linear accelerator and then crosses a molecular beam coming out of another hypersonic nozzle. In the interaction space of the two beams, charge or momentum exchanges are then produced and after deflection of ions and pumpage of slow molecules, we obtain a beam of high-speed molecules in the initial direction of the ion beam. The molecules belonging to the molecular beam are detected by means of a tungsten strip heated at a relatively low temperature. The speed is measured with a special device. The measurements that must be made by means of a high-speed molecular beam are carried out in a test chamber where a model carriage is placed. This carriage is apt to move into two directions. The apparatus, "Molecular Gun," has three diffusion pumps and two large primary pumps. In preliminary researches carried out in a vacuum tank, a beam of 3×10^{16} molecules/cm^2/sec was produced. The described apparatus permits studies of all the interactions phenomena between a body moving at a cosmic speed and a very rarefied gas in free molecular flow regime. (auth)

7871 (ARL-TN-60-138) THEORETICAL CONSIDERATION OF NONUNIFORMLY CHARGED EXPELLANT BEAMS. Robert E. Hunter (Wright Air Development Center. Aeronautical Research Lab., Wright-Patterson AFB, Ohio). Oct. 1960. 17p. Project No. 7116.

Nonuniformity of charge-mass ratio in the expellant beam of electrostatic thrust devices is shown to be expressible as a power efficiency factor. Nonuniformity in ion beams, in the form of neutral atoms and multiply charged ions, is examined and the conclusion is drawn that the existence of multiply charged ions in the specie percentages which reasonably can be expected from non-contact ion sources is not a serious problem. Presently available experimental data indicate that the colloid thrust devices will produce particles with a wide range of charge-mass ratio, possibly including ions. A generalized exponential form is assumed for the mass distribution function in terms of charge-mass ratio. The beam efficiency is shown to be critically dependent upon the range of charge-mass ratio in the beam. The presence of ions in the colloid beam is shown to be an additional serious factor. Nonuniformity of charge-mass ratio in colloid expellant beams may be serious enough to require the expellant beam to be filtered, for example, by a magnetic deflection, to recover the mass carried by neutral and slightly charged particles. In addition, the energy carried by the ions may have to be recovered.

7872 (GAMD-1488) SPECIFIC IMPULSE OF A GAS JET EXPANDING IDEALLY. C. V. David (General Atomic Div., General Dynamics Corp., San Diego, Calif.). June 27 1960. 8p. Contract AF29(601)-2207.

The theoretical specific impulse of a gas jet expanding ideally through a nozzle is given by: $I_{sp} = (kRT_c/gm)^{1/2} \{(2/k-1)\,[1-(P_e/P_c)]^{(k-1/k)}\}^{1/2}$. The I_{sp} was calculated for various values of the parameters involved and for the ranges: $1.1 \leq k \leq 1.5$; $2{,}000 \leq T_c \leq 10{,}000$; and $2 \leq m \leq 30$. P_c/P_e was kept constant at 68, which corresponds to $P_c = 1000$ psi at sea level standard conditions. Graphical representations are given of the calculated results. (B.O.G.)

7873 (GAMD-1801) MOTION OF A SPRING LOADED INFINITE ROD. T. Teichmann (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Nov. 15, 1960. 11p. Contract AF29(601)-2207.

The effects of the elasticity and mass of the supporting structure on a spring shock-absorber system were investigated using a one-dimensional model. A mathematical analysis is given of the problem, which leads to the conclusions that: when the rod is more flexible than the springs, the elastic energy stored in the spring is reduced because of the inertial effect of the rod; and when the rod is stiffer than the springs, the elastic energy is reduced because of the greater mass of the moving system and the energy storage in the rod. The variation in the elasticity between the two systems must be pronounced before the latter effect can be of importance. (B.O.G.)

7874 (JINR-D-612) A MODEL OF THE LOCAL FIELD THEORY WITH THE FINITE CHARGE RENORMALIZATION. B. M. Barbashov and G. V. Efimov (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1960. 20p.

A model of the local quantum field theory suggested by Bialynicki-Birula is treated using a method developed previously. The S-matrix and the renormalization constants were obtained. It is proved that the charge renormalization is finite for all orders and does not contain the logarithmic divergencies. It is shown that the contribution to the series from the ultraviolet region is summed toward the finite limit. It is also proved that a series for the Green function of the nucleon is absolutely convergent at small times and has a branch point at t = 0, the singularity at zero being integrable. (auth)

7875 (KAPL-M-RXS-3) RESPONSE OF A THREE MASS SYSTEM TO A STEP VELOCITY INPUT. Richard J. Simon (Knolls Atomic Power Lab., Schenectady, N. Y.). Nov. 1960. 40p. Contract W-31-109-Eng-52.

Equations are presented for determining the shock loadings generated on a series three mass system subjected to a step velocity input on the bottom mass. Solutions to date present the shock loadings in terms of the velocity of the mass to which the shock is applied. This study presents equations for determining the shock loadings in terms of the velocity of the center mass rather than the bottom mass, which receives the direct impulse. Results are plotted in charts and a numerical example is given. (auth)

7876 (NAA-SR-Memo-3024) PHYSICAL CONSTANTS FOR H_2O. R. E. Skinner (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Aug. 13, 1958. 12p.

A collection of physical constants of H_2O as a function of pressure and temperature is given. Constants given include: Henry's constant, solubility of H_2 and O_2 in H_2O, viscosity, density, thermal conductivity, surface tension, heat capacity, vapor pressure, heat of vaporization, dielectric constant, and quantities related to the equation of state. (W.D.M.)

7877 (NAA-SR-Memo-3148) VELOCITY OF SOUND IN WATER CONTAINING GAS BUBBLES. D. L. Hetrick (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Nov. 4, 1958. 13p.

The velocity of sound in water containing bubbles of hydrogen gas is computed as a function of the volume fraction of gas for various bubble sizes. Results indicate that the marked reduction in sound velocity caused by the presence of gas voids is not as great if the gas is present as very small bubbles. The results are used in qualitative observations concerning inertial pressures in fast excursions in the KEWB reactor. The qualitative conclusions are listed. (J.R.D.)

7878 (NP-9596) PLASMA SIMULATION BY ARTIFICIAL DIELECTRICS AND APPLICATION TO ANTENNA PROBLEMS. Walter Rotman and Nicholas Karas (Air Force Cambridge Research Labs., Bedford, Mass.). [1959]. 27p.

The approximate behavior of plasma was examined at a single frequency by an artificial dielectric composed of periodically spaced lattices of rods. It was found that the rodded medium can be used for determining the effects of plasma on the radiation impedance of antennas, for investigating scattering from plasma columns, and for calibrating plasma diagnostic instruments which depend on microwave radiation. (J.R.D.)

7879 (NP-9740) PHYSIQUE NUCLÉAIRE, RADIOCHIMIE. ANNUAIRE DU LABORATOIRE, ANNEE 1958–1959. (Nuclear Physics, Radiochemistry. Laboratory Annual, Years 1958-9). (Paris. Université. Institut du Radium. Laboratoire Curie et Laboratoire Joliot-Curie). 60p.

A summary is presented of work during the school year 1958-9 on nuclear reactions, spectroscopy and nuclear structure, high-energy research, and radiochemistry and nuclear chemistry. The operation of accelerators and high-voltage equipment for the period is also summarized. Data are presented on: cross sections for (p,xn) reactions on Hg^{194}, Hg^{195}, Hg^{197}, Au^{195}, and Au^{196}; cross sections for formation of At, Th, Ac, Ra, Po, and Fr by 150-Mev protons on Th^{232}; Triton formation by double pick-up reaction; β and γ spectra and half life of 160-kev level of Ba^{139}; level scheme for Au^{192}; nuclear fluorescence radiation of 265-kev level of As^{75}; decay scheme of Se^{75}. (T.R.H.)

7880 (NP-9754) PROPELLANTS FOR ELECTRICAL PROPULSION ENGINES OF THE CONTACT OR BOMBARDMENT ION TYPE. Quarterly Report [for] March 15 through June 15, 1960. (Rocketdyne Div., North American Aviation, Inc., Canoga Park, Calif.). July 1960. 108p. Project No. 3048. Contract AF33(616)-7063. (R-2513-1)

Studies of material properties, ionization characteristics, and methods of charging were made for substances under consideration for use as molecular or colloidal ion propellants in electrical propulsion devices. The property investigations include a literature survey of properties of the candidate compounds and experimental determinations of surface tension and thermal stability. Modifications of the mass spectrograph, adapting it for the investigation of the ionization characteristics of the compounds, are described. Details are presented of the design and operating conditions for a charged colloid generator employing the vapor jet rapid condensation method of colloid production with surface contact ionization. (auth)

7881 (NP-9756) PHYSICS OF THE IONIZATION PROCESSES IN AIR. PART I. FORMATION AND PRODUCTION OF IONS. An Annotated Bibliography. George R. Evans, comp. (Lockheed Aircraft Corp. Missiles and Space Div., Sunnyvale, Calif.). Nov. 1960. 114p. (SB-60-40) OTS.

Results of a search for information on formation of ions are presented. Reference sources include Applied Science and Technology Index, 1950 to 1960, Chemical Abstracts, 1950 to 1960, Engineering Index, 1950 to 1960, Meteorological Abstracts and Bibliography, 1950 to 1960, Science Abstracts, 1950 to 1960, and University of Pittsburg. Dept. of Physics. Spectroscopy Laboratory. Scientific Report No. 1. The Spectra and Chemical Kinetics of the Upper Atmosphere, Robert Resnick and Stanley Stein, published in 1952, and Supplement published in 1953. 278 references. (J.R.D.)

7882 (NP-9762) ASTRONAUTICS INFORMATION. OPEN LITERATURE SURVEY. VOLUME II, NUMBER 1-2 (Entries 20,001-20,674). (California Inst. of Tech., Pasadena. Jet Propulsion Lab.). Jan.-Feb. 1960. 71p. Contract NASw-6.

The material presented is organized alphabetically according to subject. A list of periodicals surveyed and author and subject indexes are included. (W.L.H.)

7883 (NP-9763) SUPERCONDUCTIVE PROPERTIES OF THIN TIN FILMS. Eugene C. Crittenden, Jr., John N. Cooper, and Frederick W. Schmidlin (Space Technology Labs., Inc. Physical Research Lab., Los Angeles). Nov. 2, 1960. 37p. (STL/TR-60-0000-NR356).

The superconductive properties of a carefully prepared family of eight thin tin films with thicknesses varying from 0.03 to 1.04μ were studied in the temperature range between 1.5 and 3.9°K. The films were prepared by vacuum evaporation upon polished glass substrates cooled to −20°C. Film thicknesses were measured by Fabry-Perot interferometry and were also calculated both from mass evaporated and from resistance measurements. Critical temperatures, particularly for the thinner films, were substantially above that for bulk tin, presumably because of tensile stresses. The d-c critical currents as a function of thickness t can be well approximated by an expression of the form $A(1-e^{-t/\sigma})/(1+e^{-t/\sigma})$, where A is a constant determined by the temperature and σ is about 0.16μ, essentially independent of temperature. (auth)

7884 STARK BROADENING OF HIGHER HYDROGEN AND HYDROGEN-LIKE LINES BY ELECTRONS AND IONS. Hans R. Griem (Univ. of Maryland, College Park and Naval Research Lab., Washington, D. C.). Astrophys. J. 132, 883-93(1960) Nov.

A theory for the impact broadening of overlapping lines is applied to describe the influence of electrons on the line profiles. The broadening by ions is treated by using the quasi-static theory. Approximate expressions are derived from the profile of any hydrogen-like line broadened by both electrons and ions. (auth)

7885 INTERACTION OF ELECTRONS WITH THE WAVE FIELD H_{01} IN CIRCULAR WAVE GUIDE. I. A. Gilinskii (Inst. of Radiophysics and Electronics, Siberian Branch, Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R. 134, 1055-7(1960) Oct. 11. (In Russian)

The nonlinear mechanism of electron energy transmission in interactions with a wave field H_{01} in a round waveguide is analyzed in order to determine the mechanism by which millimeter waves are generated. (R.V.J.)

7886 AN ELEMENTARY DESIGN DISCUSSION OF THERMOELECTRIC GENERATION. E. W. Bollmeier (Minnesota Mining and Mfg. Co., St. Paul). Elec. Eng. 995-1002(1959) Oct.

Elements of thermoelectric generation are reviewed and the problems confronting generator designers are discussed. Solutions are suggested; however, it is pointed out that they indicate only that these problems are being examined and have not been solved. (J.R.D.)

7887 RARE EARTH ION PROBING OF CRYSTALLINE FIELD OF $BaTiO_3$. A. F. Yatsenko and L. M. Rabkin (Rostov-on-Don State Univ., USSR). Izvest. Akad. Nauk S.S.S.R., Ser. Fiz., 24, 1314-17(1960) Nov. (In Russian)

The crystal field function (magnitude and symmetry) was determined by rare earth probing. Correlations made of $BaTiO_3$, $SrTiO_3$, and $CaTiO_3$ show that the electron cloud of the central ion octahedron remains strongly polarized above the Curie point. A strong luminescence with a large number of visual lines was achieved by introducing praseodymium and samarium into $CaTiO_3$. (R.V.J.)

7888 SPACE-CHARGE NEUTRALIZATION AND THERMIONIC EMISSION. R. N. Franklin (Clarendon Lab., Oxford). J. Electronics and Control (1), 9, 385-90(1960) Nov. (In English)

A hot surface emitting charged particles of both signs is placed near a nonemitting collector maintained at a potential relative to the emitter. The potential in the region between the electrodes is investigated. An exact solution of the density distribution of space charge and the field is derived. Though no analytical expression can be given for the potential distribution, its general shape can be found as a function of the ratio of the number of positive ions to electrons. It is shown that the transition from pure electron emission to ion emission proceeds smoothly and that no oscillatory solution for the potential exists. (auth)

7889 MICROSCOPE INSTALLATION FOR HOT CELLS. A. Lehr (Zentralinstitut für Kernphysik, Rossendorf, Ger.). H.-G. Scheplitz, F. Thümmler, and G. Ondracek. Kernenergie 3, 941-50(1960) Oct.-Nov. (In German)

A microscope installation was designed and built. The installation, which was specifically constructed for use in hot and warm cells, offers the user comfort both in servic and utility. The apparatus was installed as an experiment model in a hot cell associated with the control room of the Rossendorf research reactor. It has adapted particularly well to the unchangeable geometry. The unit was so designed that it can be adapted to other cells. (T.R.H.)

7890 THE SOFT X-RAY SPECTRA OF LITHIUM, MAGNESIUM AND ALUMINIUM AND THEIR ALLOYS. R. S. Crisp and S. E. Williams (Univ. of Western Australia, Nedlands). Phil. Mag. (8) 5, 1205-16(1960) Dec.

The Li K and Mg L_{23} spectra were observed from a ran of Li−Mg alloys, evidence for electron transfer from magnesium being obtained. More distinct changes were observed for the same spectra when lithium was evaporat onto solid magnesium and magnesium onto solid lithium. Changes in the Li K and Al L_{23} were observed when lithiu was evaporated onto aluminum and in the Al L_{23} when aluminum was evaporated onto magnesium. No changes greater than 5×10^{-2} ev were observed in edge wavelengths or edge widths although marked depopulation of higher energy states occurred in magnesium and aluminu It is inferred that changes in the screening of K and L levels compensate almost exactly for the effects of electron transfer. The results of Catterall and Trotter were confirmed in that the magnesium band contracted and the lithium band extended on the low-energy side. Lithium de posited on aluminum shows a K spectrum without any met edge, suggesting that the first zone is filled and that there is no overlap with the second zone. (auth)

7891 DIRECT EXCHANGE IN FERROMAGNETS. R. Stuart and W. Marshall (Univ. of California, Livermor and Atomic Energy Research Establishment, Harwell, Berks, England). Phys. Rev. 120, 353-7(1960) Oct. 15. (UCRL-6164-T)

The direct-exchange integral that occurs in the Heisenberg theory of ferromagnetism was evaluated for all inte nuclear spacings. It was found that it is always positive, whereas Bethe originally suggested it would be positive only at large spacing. More recently it was suggested that the integral should always be negative. However, at the observed internuclear separation, the magnitude calculated is of the order of 70 times too small to explain th experimentally determined exchange constant in ferromagnetic metals, and it was therefore concluded that dire exchange is not responsible for ferromagnetism in these metals. (auth)

7892 NUCLEAR PARAMAGNETIC SUSCEPTIBILITY OF THE POSSIBLE LOW-TEMPERATURE PHASE OF LIQUID He^3. L. H. Nosanow and R. Vasudevan (Univ. of California, La Jolla). Phys. Rev. Letters 6, 1-3(1961) Jan. 1.

Because a model of Brueckner, Soda, Anderson, and Morel based on the BCS model predicts that liquid He^3 wi undergo a second-order phase transition to a highly corre lated phase at ~0.06°K, the behavior of liquid He^3 in the

presence of a magnetic field is calculated on the basis of the model, using the method of Bogoliubov et al. A critical magnetic field is found above which the low-temperature phase cannot exist, but the critical field is so high ($\sim 10^6$ gauss) that the result reduces to Yosida's result in the spherically symmetric case. A plot of the magnetic susceptibility vs. temperature for the case l = 2, m = 2 shows that an attraction in He^3 in relative d states predicts a rather sharp drop in the susceptibility at the critical temperature. Since no such sharp change was observed down to 0.035°K, it is concluded that there is no evidence for a highly correlated low-temperature phase of He^3 above 0.035°K. (D.L.C.)

7893 ANOMALOUS NEUTRON DIFFRACTION IN α CADMIUM SULFIDE. S. W. Peterson and H. G. Smith (Oak Ridge National Lab., Tenn.). Phys. Rev. Letters 6, 7-9 (1961) Jan. 1.

Anomalous neutron scattering (failure of Friedel's law) was observed in experiments with alpha CdS containing neutron-absorbing Cd^{113} and a space group Pómc, in which the integrated intensities of (hkl) and ($\bar{h}\bar{k}$l) mates of a series of reflections were measured at several wavelengths. The $I_{002}/I_{00\bar{2}}$ ratio showed a strong energy dependence, due to the variation of the complex amplitude of cadmium with the wave length, which agrees with the Breit-Wigner theory. The intensity inequalities were compared for x rays and neutrons on one CdS crystal; the direction of the phase shift was found to be the same for both. Possible applications of anomalous neutron scattering are discussed. (D.L.C.)

7894 ANGULAR DISTRIBUTION OF LYMAN-α RADIATION EMITTED BY H (2S) ATOMS IN WEAK ELECTRIC FIELDS. William Lichten (Univ. of Chicago). Phys. Rev. Letters 6, 12-13(1961) Jan. 1.

The angular distribution of the Lyman-α radiation emitted by hydrogen atoms in the 2S state upon the application of an electric field is studied by considering the $2P_{\frac{1}{2}}$ levels; the radiation is found to be completely unpolarized and its angular distribution isotropic. The consequences of this result for the value of the absolute cross section for excitation of the 2S state of hydrogen by electron impact are discussed. (D.L.C.)

7895 INFLUENCE OF HIGH PRESSURE ON THE EMISSION AND EXCITATION SPECTRA OF ALKALI HALIDE PHOSPHORS ACTIVATED BY EUROPIUM. Ya. Ya. Kirs and A. I. Laĭsaar. Trudy Inst. Fiz. i Astron., Akad. Nauk Eston. S.S.R. No. 12, 42-8(1960). (In Russian)

The influence of high hydrostatic pressure on the emission bands and long wavelength excitation bands of the phosphors NaCl(Eu), KCl(Eu), KBr(Eu), and KI(Eu) was investigated. A pressure of 6000 atm led to a shift of 0.02 to 0.035 ev in the emission spectra of these phosphors toward a longer wavelength. Phosphors conspicuous for the greatest compressibility also showed slight shifts of the excitation bands toward a longer wavelength. The results obtained indicate that the diminution of interionic distances in the phosphors investigated leads to the "compression" of the energy spectrum of luminescence centers. (auth)

7896 CONCENTRATION QUENCHING IN NaCl–Ag PHOSPHORS. L. A. Rebane. Trudy Inst. Fiz. i Astron., Akad. Nauk Eston. S.S.R. No. 12, 49-66(1960). (In Russian)

Absorption, emission, and excitation spectra of NaCl(Ag) phosphors with different concentrations of the activator were investigated. The quantum yield in such phosphors was studied for separate emission bands (λ_{max} = 247 mμ and 400 mμ) in its dependence on the concentration of the activator. Two kinds of centers, containing a different number of activator ions, are shown to be present in NaCl(Ag) phosphors. It is also shown that a competition between these two kinds of centers in absorbing quanta of the exciting light plays a leading part in the process of concentration quenching in the phosphors under discussion. (auth)

7897 THE INFLUENCE OF THE CONCENTRATION OF COPPER ON SOME SPECTRAL PROPERTIES OF ZnS–Cu, Cl PHOSPHORS. K.-S. K. Rebane. Trudy Inst. Fiz. i Astron., Akad. Nauk Eston. S.S.R. No. 12, 67-76 (1960). (In Russian)

Emission spectra of phosphors subjected to irradiation with infrared light and without such irradiation, excitation spectra of blue and green bands, the coefficient of infrared quenching, and the power of nonlinearity α were obtained and studied from the point of view of their dependence upon the concentration of copper in ZnS phosphors. (auth)

7898 RADIATIONLESS TRANSITIONS IN THE LUMINESCENCE CENTERS OF ALKALI HALIDE PHOSPHORS. K. K. Shvarts, G. K. Vale, and B. Ya. Zunde. Trudy Inst. Fiz. i Astron., Akad. Nauk Eston. S.S.R. No. 12, 77-110 (1960). (In Russian)

Radiationless transitions in the alkali halide phosphors NaCl, KCl, and KBr activated by the ions In^+, Sn^{++}, Tl^+, and Pb^{++} were studied. Experimental results are compared with theoretical ideas concerning radiationless transitions in crystals. There are three possible mechanisms of radiationless transitions: thermally activated radiationless transitions, optically activated radiationless transitions, and tunnel radiationless transitions. Experiments revealed only thermally activated radiationless transitions in the case of alkali halide phosphors activated by mercury-like ions. Such transitions cause the well-known thermal quenching of luminescence. Detailed investigation of thermally activated radiationless transitions showed that they conform with the quasi-molecular model of an impurity center. Radiationless transitions occur after the establishment of equilibrium between an excited center and the crystalline lattice at vibration levels, take place across the activating barrier, and depend exponentially upon 1/T, where T is temperature. (auth)

7899 PHOSPHORS ON THE BASIS OF HALIDE SALTS OF SOME SECOND-GROUP METALS. A. F. Malysheva. Trudy Inst. Fiz. i Astron., Akad. Nauk Eston. S.S.R. No. 12, 111-24(1960). (In Russian)

Absorption, excitation, and emission spectra, were investigated in phosphors of halide salts of some second-group metals activated with lead and thallium. The absorption (excitation) band maxima of these phosphors were compared with the electronic transitions in free lead and thallium ions. A slight difference was noted between the structures of the absorption spectra of this group of phosphors and alkali halide phosphors with the same activators. In particular, there was an absence of splitting (or the presence of very weak splitting) of the levels $^1P_1$ in the ions Tl^+ and Pb^{++} in the lattices of halide salts of the second-group metals (this despite the low symmetry of the lattices of the latter). A comparison of the emission spectra of thallium phosphors on the basis of halide salts of alkali and alkali earth metals led to the conclusion that one type of center exists in the second phosphor group, whereas it is possible that two types of centers exist in the first group. This difference was attributed to the different cation charges of the host crystals in these two groups of phosphors. Absorption spectra of the pure halide salts of first- and second-group metals were considered. (auth)

7900 A SPECTROPHOTOMETRIC INVESTIGATION OF THE DELOCALIZATION OF EXCITATIONS IN IONIC CRYSTALS. Ch. B. Lushchik and E. S. Tiĭsler. Trudy Inst. Fiz. i Astron., Akad. Nauk Eston. S.S.R. No. 12, 125-48(1960). (In Russian)

Variations in the absorption spectra of the phosphors KBr(Sr, Ga); KBr(Sr, In); KCl(Ca, Tl); and others subjected to ultraviolet light were investigated. The action of radiation spectra on the absorption characteristics of phosphors was measured. The question of the delocalization of excitations in ionic crystals is discussed on the basis of results obtained in the course of the present and earlier work. (auth)

7901 THE INTERACTION OF EXCITONS WITH DEFECTS IN ALKALI HALIDE CRYSTALS. G. G. Liid'ya. Trudy Inst. Fiz. i Astron., Akad. Nauk Eston. S.S.R. No. 12, 149-74(1960). (In Russian)

A systematic account is given of the basic types of possible reactions arising from the interaction of excitons and various defects in alkali halide crystals. An attempt was made to corroborate experimentally that such processes actually occur. For this purpose experiments were performed in which the irradiation of crystals in the exciton absorption band led to photochemical change or to the luminescence of the activator. The origin of V_1 and F centers in KBr(Sr) and KCl(Sr), the interaction of excitons and the divalent ions of the activator (Pb^{++}, Sn^{++}, Ge^{++}, Mn^{++}) in KBr, and the origin of Z_1 centers ($Sr^{++}e$) in KCl-Sr were investigated. Such cases involved the exciting action of excitons. The spectra of photochemical activity showed that the maximum efficiency of these conversions falls within the long wavelength edge of the exciton band. The interaction of excitons with the complex centers in colored KCl crystals and with atomic centers (Tl) in KBr(Tl) was also studied. The bleaching action of excitons could be observed. The excitation of the emission of thallium in the exciton absorption band of KI(Tl) and CsI(Tl) was investigated. Here the excitons are responsible for the migration of energy from the host crystal to the luminescence centers. (auth)

7902 THE COMPLEX INVESTIGATION OF NONISOTHERMIC RELAXATION PROCESSES IN ALKALI HALIDE CRYSTALS. I. K. Vitol, Ch. B. Lushchik, and I. V. Yaek. Trudy Inst. Fiz. i Astron., Akad. Nauk Eston. S.S.R. No. 12, 175-96(1960). (In Russian)

A number of optical, electric, and magnetic methods of the investigation of electronic-hole relaxation processes in alkali halide crystals are considered. Some possibilities, arising from the complex investigation of a number of relaxation characteristics by means of the application of several deexcitating factors, are analyzed and illustrated. Special attention is paid to the investigation of the relaxation of physical characteristics scanned in spectra in conditions where the deexcitating factor increases with time. (auth)

7903 AN INVESTIGATION OF THERMAL DESTRUCTION OF F-CENTERS IN NaCl SINGLE CRYSTALS. M. A. Elango. Trudy Inst. Fiz. i Astron., Akad. Nauk Eston. S.S.R. No. 12, 197-225(1960). (In Russian)

The processes of the thermal destruction of F-centers in NaCl single crystals were investigated by means of glow curves and thermal bleaching. It is shown that thermal destruction of F-centers in these crystals takes place at temperatures considerably lower than those theoretically predicted for direct thermal ionization, depends on the composition of the crystal and on a number of physicochemical factors (plastic deformation, thermal treatment, etc.), and is connected with ionic processes. Color centers were destroyed at temperatures of less than half the melting point of the crystal, at which the intensity of diffusion processes increased considerably. The principal part in the destruction of color centers at temperatures higher than room temperature took place by ionic processes. This was examined by the measurement of the ionic conduction of a number of phosphors. The possibility of a number of ionic-electronic and ionic-hole processes that can cause the destruction of color centers is discussed. (auth)

7904 AN INVESTIGATION OF THE EFFICIENCY OF THERMOLUMINESCENCE CONNECTED WITH THE THERMAL BLEACHING OF ALKALI HALIDE CRYSTALS. I. V. Yaek. Trudy Inst. Fiz. i Astron., Akad. Nauk Eston. S.S.R. No. 12, 226-40(1960). (In Russian)

Thermoluminescence connected with the thermal bleaching of a number of x-irradiated alkali halide crystals was investigated by means of the relaxation combine. It is shown that within the limits of separate elementary stages of thermal bleaching the efficiency of thermoluminescence is constant. The efficiency of thermoluminescence for various elementary stages is different. The causes of observed regularities are discussed. (auth)

7905 ON ELECTRON EMISSION FROM X-IRRADIATED CRYSTAL NaCl. A. I. Belkind. Trudy Inst. Fiz. i Astron., Akad. Nauk Eston. S.S.R. No. 12, 241-8(1960). (In Russian)

A complex investigation was made of electron emission from NaCl crystals. Results were achieved in the simultaneous measurement of thermal bleaching and thermo-optical stimulation and thermoelectronic emission and photothermoelectronic emission. It is shown that the process of thermal bleaching has many stages and that electronic processes play the principal role at high temperatures. (auth)

7906 THE PHOTOELECTRIC POLARIZATION OF ZINC AND CADMIUM SULPHIDE MIXED PHOSPHORS. U. Kh. Nymm and A. K. Aĭdla. Trudy Inst. Fiz. i Astron., Akad. Nauk Eston. S.S.R. No. 12, 249-61(1960). (In Russian)

The photoelectric polarization of mixed phosphors was investigated. Attention was concentrated on the spectral regularities of photoelectric polarization in this series of phosphors and on the determination of the signs of photocurrent carriers. A close connection was found to exist between the excitation spectra of photoelectric polarization and other spectra of the same samples. Photoconduction in the fundamental absorption band was found to be caused chiefly by free electrons. (auth)

7907 SPECTROSCOPY OF IMPURITY CENTERS IN ALKALI HALIDE CRYSTALS ACTIVATED BY COPPER, SILVER AND GOLD. N. E. Lushchik and S. G. Zazubovich. Trudy Inst. Fiz. i Astron., Akad. Nauk Eston. S.S.R. No. 12, 267-70(1960). (In Russian)

Analyses of absorption excitation and emission spectra of KBr–Cu(100°K), KBr–Ag(100°K), and KBr–Au(300°K) indicate the ions Cu^+, Ag^+, and Au^+ are the luminescence centers interacting with the surrounding crystalline lattice. The basic lines of the activated absorption (excitation) correspond to transitions $nd^{10} \rightarrow nd^9(n+1)p$. The emission of the phosphors is linked with long-wave lines of activated absorption and corresponds to electron transition $nd^9(n+1)p \rightarrow nd^{10}$ (for KBr–Ag it is $^3P_2 \rightarrow {}^1S_0$). The closely distributed energy levels of Cu^+, Ag^+, and Au^+ interfere with the determination of the relation between the centers and free ions. (R.V.J.)

7908 ROLE OF DISLOCATION AND BOUNDARY GRAIN IN LUMINESCENCE OF ALKALI HALIDE PHOS-

PHORS. R. I. Gindina. Trudy Inst. Fiz. i Astron., Akad. Nauk Eston. S.S.R. No. 12, 271-4(1960). (In Russian)

Microscopic studies were made of the role of dislocations and boundary grains in NaCl–Pb, KCl - Ag, KCl–Cu, KBr–Au, KI– Tl, and NaCl–Pb and Mn. Crystal annealing, causing accumulation of admixtures on the grain surface, does not increase activation absorption and luminescence. Plastic deformation of KCl–Tl, KBr–Tl, KI–Tl, and KBr–In crystals under 40 to 50% compression does not affect the activation absorption. The luminescence of KI–Tll, KBr–In, and the unstable system KCl–Cu is uniformly distributed in the crystalline lattice, indicating the luminescence is not related to the boundary grain. Hence, it is confirmed that activator ions distributed in the lattice are the principle centers of luminescence in alkali halide crystals. (R.V.J.)

7909 EXCITON, ELECTRONIC AND HOLE PROCESSES IN AMMONIUM HALIDE PHOSPHORS. Ch. B. Lushchik and L. Ya. Uĭbo. Trudy Inst. Fiz. i Astron., Akad. Nauk Eston. S.S.R. No. 12, 275-7(1960). (In Russian)

The optical characteristics of alkali halide crystals, ammonium-halide crystals, and halide salts of Ca, Sr, and Ba are very similar and their excitation processes are identical. However, the optical characteristics of their color center are quite different. The optical and thermal characteristics of color center and the thermoluminescence of hole processes at 100 to 300°K are similar in alkali and ammonium halide crystals. Correlated data show that the anion sublattices in both crystals are basically similar but that the cation sublattices are quite different. (R.V.J.)

7910 NON-STATIONARY MOTION PROBLEM NEAR TO AUTOMODEL. T. G. Koldobskaya. Vestnik Leningrad. Univ. 15, No. 1, Ser. Mat. Mekh. i Astron. No. 1, 111-22 (1960). (In Russian)

Plane and axially-symmetrical nonstationary gas motions near to automodel are considered. A method of linearization near the known automodel solution is used. The method can be applied to a problem of plane shock-wave flow around the body near a wedge or a cone. (auth)

7911 NEW METHOD OF A HIGH-ORDER FOCUSING MAGNETIC FIELD CALCULATION. V. R. Saulit. Vestnik Leningrad. Univ. 15, No. 4, Ser. Fiz. i Khim. No. 1, 33-40 (1960). (In Russian)

A method of calculation for high-order focusing of magnetic field is presented; the solution of the problem is given for an inhomogeneous field depending on one cartesian coordinate being found in the form of polynoms. The magnetic field thus obtained is proved to have continuous derivatives. One can obtain the electron- or ion-beams of a desirable form. As an example a magnetic field giving seventh-order focusing is calculated. (auth)

7912 INHOMOGENEOUS FOCUSING MAGNETIC FIELDS FOR FOCUSING PLANE BEAMS OF CHARGED PARTICLES. V. R. Saulit and V. A. Unt. Vestnik Leningrad. Univ. 15, No. 10, Ser. Fiz. i Khim. No. 2, 28-33 (1960). (In Russian)

Focusing properties of inhomogeneous magnetic fields depending on only one cartesian coordinate were examined in the symmetry plane. The general condition for ideal focusing of plane beams of charged particles was obtained in the form of a nonlinear integral equation; the solution of this equation was found. The type of magnetic field that makes it possible to avoid numerical integration is given; the calculations for a particular case were made. (auth)

7913 DIPOLE ELECTROMAGNETIC METHOD FOR DETERMINATION OF A FINITE CONDUCTIVE LAYER. G. V. Molochnov. Vestnik Leningrad. Univ. 15, No. 10, Ser. Fiz. i Khim. No. 2, 34-44(1960). (In Russian)

Formulas for the field of a vertical magnetic dipole in the case of finite conductivity of the first (upper) and second (lower) layers are developed. Displacement currents in the air are considered. The depth of the buried conductive layer is shown to be determined by expressions for the infinitely conductive base, providing the depth of electromagnetic field penetration to the second layer is considered. (auth)

7914 CORRECTION TO THE SECOND MOMENT OF NUCLEAR MAGNETIC RESONANCE LINE OBSERVED BY MEANS OF PHASE-SENSITIVE DETECTORS. N. M. Aleksandrov and V. V. Moskalev. Vestnik Leningrad Univ. 15, No. 10, Ser. Fiz. i Khim. No. 2, 55-8(1960). (In Russian)

It is shown that for sufficiently slow scanning the true second moment of a nuclear magnetic resonance line may be found from the experimental value $\Delta\overline{H}^2_{exp}$ by means of the equation $\Delta\overline{H}^2_{tr} = \Delta\overline{H}^2_{exp} - (\tau_0 v)^2$, where τ_0 is the time constant of the detecting system and v is the rate of scanning through the line (in deg/sec); $\Delta\overline{H}^2_{exp}$ is to be computed with reference to the observed (i.e., displaced by the influence of the time constant) center of the resonance line or its derivative. Some experimental criteria of validity of the equation are given. (auth)

7915 CALCULATION OF POLARIZABILITY OF NEGATIVE HYDROGEN IONS. M. L. Veselov and L. N. Labzovskiĭ. Vestnik Leningrad. Univ. 15, No. 16, Ser. Fiz. i Khim. No. 3, 5-6(1960). (In Russian)

The value of the polarizability of a negative hydrogen ion is calculated by the variational method. (auth)

7916 THE MEASUREMENT OF THE PARTICLE-SIZE DISTRIBUTION OF AEROSOLS. Christian Heinrich Martius (Universität, Göttingen, Ger.). Z. Naturforsch. 15b, 642-6(1960) Oct. (In German)

Monodispersed and heterodispersed liquid aerosols were investigated on the basis of drop size or drop size distribution. This was done microscopically with a new apparatus by measurement of the drop velocity of the droplets in the gravitational field and macroscopically by measurement of the higher order Tyndall spectra in scattered light. The combination of both methods shows that the higher Tyndall spectra begin to disappear when the relative scattering of the drop radius in the system considered amounts to ±3%. This shows the necessity of a stricter wording of the conception of monodispersion for which previously a relative scattering of ±10% was assumed permissible. The experimental measurement of the angular position of the red band of the higher Tyndall spectra as a function of the droplet radius for the relative refractive index m = 1.486 is a further result. (tr-auth)

7917 MAGNETOHYDRODYNAMIC SHOCK WAVES IN A GAS MIXTURE. K. P. Chopra and I. J. Singh (Univ. of Southern Calif., Los Angeles and Oil and Natural Gas Commission, Dehradun, India). Z. Physik 160, 431-7(1960). (In English)

The properties of the nonrelativistic propagation of a plane shock wave in a gas mixture of charged particles in the presence of an external uniform magnetic field, oriented in a direction transverse to the direction of propagation, are studied. Expressions for the pressure, density, and velocity ratios are obtained. It is shown that the presence of a transverse magnetic field narrows down the range of values of the density ratio. (auth)

7918 MAGNETOHYDRODYNAMIC WAVES IN WAVE GUIDES. J. Szabo (Univ., Budapest). Z. Physik 160, 491-3(1960). (In German)

Magnetohydrodynamic waves in cylindrical waveguides were investigated. The exterior magnetic field is parallel to the waveguide. The fluidity is taken as ideal. The discussion is limited to waves of small amplitude. (tr-auth)

7919 THE LIGHT YIELD OF ORGANIC SCINTILLATORS FOR ELECTRONS OF 1 TO 12 Kev. Hans-Henning Kausch-Blecken von Schmeling (Universität, Göttingen, Ger.). Z. Physik 160, 520-6(1960). (In German)

A method is described for measuring the scintillation response of anthracene and organic plastic scintillators for electrons of 1 to 12 kev. It shows that the scintillation response is a linear function of the electron energy down to energies of 4 to 5 kev. Scintillator thickness and surface preparation are of great importance for a linear scintillation response. (auth)

7920 AN INVESTIGATION OF THE ELECTRON COMPONENT OF ELECTRON AVALANCHES IN HOMOGENEOUS FIELDS. [PART] II. L. Frommhold (Universität, Hamburg). Z. Physik 160, 554-67(1960). (In German)

Electron avalanches in uniform fields are studied by means of a short-duration spark light source. Electron drift velocities v_- are measured in hydrogen, nitrogen, oxygen, and some vapors. It is shown that in hydrogen and nitrogen the number of electrons increases exponentially by gas amplification with a time constant $1/\alpha v_-$, in accordance with a conventional assumption and with previous measurements in methane, α is the first Townsend coefficient. In oxygen and air it is, however, demonstrated that the number of electrons increases considerably less than $\exp(\alpha v_- t)$, and the multiplication process takes longer time. This is evidently due to time losses of the electrons on their paths across the gap. Thus the mean time interval for successors, started by photons at the cathode, is increased. In addition, details are given of some measurements of the first Townsend coefficient α, the electron diffusion coefficient, and ionic drift velocities for certain gases. (auth)

7921 POLARIZATION AND FOCUSING OF MOLECULAR BEAMS BY DIPOLES. H. Friedmann (Universität, Munich). Z. Physik 161, 74-88(1961). (In German)

Dipole fields with two symmetry planes and nonvanishing fields on the symmetry axis focus molecules with constant or field-strength dependent dipole moments according to their orientation to the field in one or both symmetry planes. They have the advantage of a very simple geometry compared to hexapole fields. If one establishes a slit in a symmetry plane as the source, then a significantly greater intensity, compared with hexapole or quadrupole fields, of polarized particles is focused in this plane with just as good separation of undesired spin orientations. Since the field has practically a uniform direction and does not vanish, it is suitable for orientation of atomic spins. An experimental intensity of polarized K atoms of 10^{14} particles/sec was attained, corresponding to 16 μamp. (tr-auth)

7922 BATTERIES. (INCLUDES BATTERIES: STORAGE, ALKALINE, NUCLEAR, GENERAL, AND BATTERY CHARGERS), 1933-58. (Office of Technical Services, Washington, D. C.). June 1959. 10p. (CTR-372). $0.10 (OTS).

The bibliography contains a title listing of 269 reports on various battery types (alkaline, general, nuclear, and storage) and battery chargers for 1933 to 1958. (OTS)

7923 ELECTRICAL POWER FROM ROCKETS. J. H. Huth (RAND Corp., Santa Monica, Calif.). Presented at the Semi-Annual Meeting of the American Rocket Society, Los Angeles, May 9-12, 1960. New York, American Rocket Society, 1960. 14p.

The characteristics of magnetohydrodynamic generators, as applied to ground-base chemical-rocket exhausts, are discussed. Simple open-cycle units can have ultimate efficiencies up to 40%, and can provide electrical power on very short notice. More specifically, rocket-powered MHD generators are suited to applications requiring hundreds or thousands of electrical megawatts for a few minutes. Within this range power densities (including the magnet) of at least 250 kw/ft^3 can be foreseen. The main problems center about developing suitable materials for operation near 2000 to 3000°K. No moving parts are required in the MHD generator, where these temperatures manifest themselves. (auth)

7924 THERMOELECTRICITY. (Office of Technical Services, Washington, D. C.). Sept. 1960. 10p. (SB-432). $0.10(OTS).

This bibliography includes 116 PB reports, AEC reports, and translations on thermoelectricity added to the OTS collection during the period 1945 to October 1960. (OTS)

7925 LECTURES ON INTEGRATION OF THE EQUATIONS OF MOTION OF A RIGID BODY ABOUT A FIXED POINT. (Lektsii po Integrirovaniyu Uravnenii Dvizheniya Tyazhelogo Tverdogo Tela Okolo Nepodvizhnoi Tochki). V. V. Golubev. 236p. Translated from a Publication of State Publishing House of Theoretical Technical Literature, Moscow, 1953. $2.50(OTS). (OTS-60-21163; PST Cat. No. 100).

The book, an adaptation of a course of lectures given for several years at Moscow State University, develops the analytical methods for the solution of equations of motion for a rigid body about a fixed point. The eight chapters cover the following topics: first integrals, postmultipliers, S. A. Kovalevskaya's problem, reduction of integrals to quadratures, theory of algebraic functions, Riemann surfaces, elliptic and hyperelliptic integrals, theta functions, degenerate cases, and special cases of integration. (D.L.C.)

7926 SPUTTERING OF METALS AND SEMICONDUCTORS BY LOW ENERGY ARGON IONS. N. Laegreid and G. K. Wehner (General Mills, Inc., Minneapolis). p.164-9 of "Sixth National Symposium on Vacuum Technology; Transactions, October 7, 8, and 9, 1959, Philadelphia, Pennsylvania." New York, Pergamon Press Inc., 1959.

Sputtering yields for polycrystalline semiconductor and metal targets under normally incident Ar^+-ion bombardment were measured in the energy range from 30 to 800 ev. The measurements were made in a low pressure (2 to 5 μ) high density argon plasma created in a demountable low-voltage hot-cathode discharge tube. The yields (number of atoms removed/incident ion) were determined by measuring the weight loss of spherical targets immersed like large negative Langmuir probes in the plasma. The yields are independent of gas pressure (below p = 30 μ), ion current density, and target temperature. At 100 ev ion energy the yields range from 0.06 atoms/ion for silicon to 0.6 atoms/ion for silver. The curves are discussed in terms of the ion parameters. (auth)

7927 BALLISTIC MISSILE AND SPACE TECHNOLOGY. Vol. II. PROPULSION AND AUXILIARY POWER

SYSTEMS. Proceedings of the Fifth Symposium on Ballistic Missile and Space Technology, Los Angeles, California, August 1960. Donald P. LeGalley, ed. New York, Academic Press, 1960. 451p. $9.00.

Unclassified papers are given which were presented at the Fifth Symposium on Ballistic Missile and Space Technology held in Los Angeles, Calif., on Aug. 29 to 31, 1960. Separate abstracts have been prepared for four of the papers. (D.L.C.)

7928 ISOTOPIC FUELED THERMIONIC GENERATORS. Robert J. Harvey (The Martin Co., Baltimore, Md.) and G. N. Hatsopoulos. p.409-41 of "Ballistic Missile and Space Technology. Vol. II." New York, Academic Press, 1960.

The progress of the thermionic generator phase in the SNAP-3 program is outlined. The advantages of the close-spaced vacuum diode over the cesium plasma diode are discussed; the vacuum diodes are usable over a wide power range, whereas the cesium devices would be limited to special applications. The performance of a vacuum diode thermionic converter is analyzed; thermal efficiency, radiation heat transfer, electron cooling, heat losses, and optimum efficiency are considered. Optimum characteristic design charts were computed for a family of diodes having a spacing of 0.001 cm, a collector work function of 1.85 v, and a collector temperature of 900°K. The criteria for choosing the isotope as the heat source are discussed; a study of the available isotopes shows only two isotopes to be suitable for thermionic generators, Cm^{242} and Pu^{238}. A two-stage electrically heated generator was built and tested electrically and dynamically (acceleration and vibration tests), and some of the results are reported. (D.L.C.)

7929 PROGRESS IN NUCLEAR PHYSICS. Vol. 8. O. R. Frisch, ed. New York, Pergamon Press, 1960. 304p. $15.00.

Six papers of a review nature, all of which are abstracted, are presented on the following subjects: cosmic ray composition, reactions of polarized nucleons, collective nuclear motion, dispersion relations, methods for detecting the Cherenkov effect, and photoproduction of pions. (D.L.C.)

7930 TRANSIENT AND STEADY STATE BEHAVIOR IN CESIUM ION BEAMS. J. M. Sellen and H. Shelton (Thompson Ramo Wooldridge Inc., Canoga Park, Calif.). Preprint 1379-60 of the "ARS Electrostatic Propulsion Conference, U. S. Naval Postgraduate School, Monterey, Calif., 3-4, November 1960." 1960. 62p.

A series of experiments with broad cesium ion beams are described in which transient and steady state behavior were studied. Steady state beams with unipolar flow characteristics exhibited the effects of radial spreading and the phenomena associated with the formation of a virtual source. It was demonstrated that these beams may be generated, but the necessary conditions to prevent trapped electrons from obscuring the positive space charge fields were such that it appeared unlikely that the high-voltage, high-perveance beams encountered in propulsive applications could be operated under laboratory conditions without collection of this trapped negative charge. The formation of these trapped electrons was studied in pulsed ion beams. An analysis was made of the energy of the ions as they arrived at the collector. A series of "blocking" oscillations was observed and a mechanism is advanced to account for this behavior. A beam of ions and electrons exhibited a stable nonoscillatory behavior in an experiment in which the collector was allowed to float. (M.C.G.)

7931 MAGNETOHYDRODYNAMIC POWER GENERATION. Arthur Kantrowitz (Avco Corp., Everett, Mass.). p.61-7 of "Proceedings of the American Power Conference, March 29, 30, 31, 1960, Chicago, Illinois. Vol. XXII." Chicago, Illinois Institute of Technology.

Shock tube experiments were performed to investigate the feasibility of a magnetohydrodynamic (MHD) generator; results are presented for the gas conductivity vs. Mach number, plasma retardation by the magnetic field, and annular gas current. It is concluded that the behavior of gases at high temperatures can be predicted. A MHD generator using argon seeded with K_2CO_3 was constructed and curves of its characteristics are presented as a function of current. The MHD generator was then evaluated for practical power generation; gas conductivity and power curves as a function of temperature were derived. Temperatures ~2000°K and a minimum size are required for the generator for power generation. Both nuclear and combustion cycles for heating the gas are considered, and it is concluded that the combustion cycle entails less serious problems from the materials standpoint. The capital costs of a MHD generator reaching temperatures ~3600°F were analyzed and found to be competitive with those of a steam plant. (D.L.C.)

7932 ISOTOPIC HEAT AND POWER. Douglas Harvey (The Martin Co., Baltimore). p.68-77 of "Proceedings of the American Power Conference."

A survey on radioisotopes as self-contained sources of power is presented in which some of the factors involved in radioisotopic power source design and some of their possible applications are described. A radioisotopic power source comprises a radioisotope fuel, an energy conversion device, and a heat sink. Some of the characteristics, e.g., useful power density and half life, of promising radioisotope fuels are presented. The possible biological hazards of these fuels are discussed. An extensive testing program is under way for testing encapsuled radioisotopes under high impact and temperature conditions. Three forms of energy conversion devices are being considered: turboelectric, thermoelectric, and thermionic. The characteristics of the SNAP III B generator, the prototype of space power sources, are presented, and some of the results of the vibration tests of this generator type are given; no failure or bad effects occurred for accelerations of 15 g lasting 5 min and of 50 g lasting 1 μsec. Thermoelectric power sources now are being designed for greater weight savings and lifetime, and thermionic sources are on the way. An extremely insoluble form of strontium was developed as a pelletized titanate for surface applications with small biological hazard. Specific surface applications are discussed, such as remote weather stations, mountain top radio and light beacons, buoys, and underwater use. Radioisotopes can also be used as heat sources, e.g., tube and battery heaters. It is concluded that radioisotopes make possible the construction of rugged power sources of long lifetime (6 months to 10 yr) in the power range 1 to 500 watts. (D.L.C.)

7933 ION PULSE GENERATION. R. F. King, C. D. Moak, and V. E. Parker (to U. S. Atomic Energy Commission). U. S. Patent 2,956,169. Oct. 11, 1960.

A device for generating ions in an ion source, forming the ions into a stream, deflecting the stream rapidly away from and back to its normal path along the axis of a cylindrical housing, and continually focusing the stream by suitable means into a sharp, intermittent beam along the axis is described. The beam exists through an axial aperture into a lens which focuses it into an accelerator tube. The ions in each burst are there accelerated to very high energies and are directed against a target placed in the high-energy end of the tube. Radiations from the target

can then be analyzed in the interval between incidence of the bursts of ions on the target.

7934 NEUTRON SOURCE. N. K. Bernander, et al. (to U. S. Atomic Energy Commission). U. S. Patent 2,957,096. Oct. 18, 1960.

An apparatus is described for producing neutrons through target bombardment with deuterons. Deuterium gas is ionized by electron bombardment and the deuteron ions are accelerated through a magnetic field to collimate them into a continuous high intensity beam. The ion beam is directed against a deuteron pervious metal target of substantially the same material throughout to embed the deuterons therein and react them to produce neutrons. A large quantity of neutrons is produced in this manner due to the increased energy and quantity of ions bombarding the target.

7935 SEPARATION OF GASES BY DIFFUSION. R. E. Peierls, F. E. Simon and H. S. Arms (to U. S. Atomic Energy Commission). U. S. Patent 2,964,124. Dec. 13, 1960.

A method and apparatus are given for the separation of mixtures of gaseous or vaporous media by diffusion through a permeable membrane. The apparatus consists principally of a housing member having an elongated internal chamber dissected longitudinally by a permeable membrane. Means are provided for producing a pressure difference between opposite sides of the membrane to cause a flow of the media in the chamber therethrough. This pressure difference is alternated between opposite sides of the membrane to produce an oscillating flow through the membrane. Additional means is provided for producing flow parallel to the membrane in opposite directions on the two sides thereof and of the same frequency and in phase with the alternating pressure difference. The lighter molecules diffuse through the membrane more readily than the heavier molecules and the parallel flow effects a net transport of the lighter molecules in one direction and the heavier molecules in the opposite direction within the chamber. By these means a concentration gradient along the chamber is established.

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7936 (LMSD-895006) SATELLITE ENVIRONMENT HANDBOOK. F. S. Johnson, ed. (Lockheed Aircraft Corp. Missiles and Space Div., Sunnyvale, Calif.). Dec. 1960. 164p. OTS.

A comprehensive review of readily available data describing the geophysical environment encountered by artificial earth satellites is presented. Included are data on the physical properties of the upper atmosphere, ionospheric structure, penetrating particle radiation, solar radiation, micrometeorites, radio noise, thermal radiation from the earth, and geomagnetism. For the physical properties of the upper atmosphere, two models are presented, one for solar maximum and one for solar minimum. Data on penetrating particle radiation constitute a rather comprehensive description of the radiation environment around the earth; the data in this field are so contradictory that a great deal of study is required to arrive at well-considered conclusions. The remaining sections are straightforward compilations of generally available data. 121 references. (auth)

7937 NUCLEOSYNTHESIS IN SUPERNOVAE. F. Hoyle (St. John's Coll., Cambridge, Eng. and California Inst. of Tech., Pasadena), and William A. Fowler. Astrophys. J. 132, 565-90(1960) Nov.

The role of Type I and Type II supernovae in nucleosynthesis is discussed. It is concluded that e-process formation of the iron-group elements takes place in Type II supernovae, while r-process formation of the neutron-rich isotopes of the heavy elements takes place in Type I supernovae. The explosion of Type II supernovae is shown to follow implosion of the nondegenerate core material. The explosion of Type I supernovae results from the ignition of degenerate nuclear fuel in stellar material. (auth)

7938 THE PROBABILISTIC METHOD FOR PROBLEMS OF RADIATIVE TRANSFER. X. DIFFUSE REFLECTION AND TRANSMISSION IN A FINITE INHOMOGENEOUS ATMOSPHERE. Sueo Ueno (Kyoto Univ.). Astrophys. J. 132, 729-45(1960) Nov.

The probabilistic method was used to obtain exact solutions of transfer equations for diffuse reflection and transmission of parallel rays by a finite plane-parallel atmosphere of arbitrary stratification. The solutions are expressed in terms of generalized X- and Y-functions of Chandrasekhar. They are new, except for one of them which was given by Bellman and Kalaba. While a pair of the scattering and transmission functions for each of the two boundaries of the atmosphere possesses polarity, the integral equations for those functions are made tractable by means of the reciprocity principle. When the albedo is constant throughout the atmosphere, the solutions reduce to those given by Chandrasekhar. Some diffusion problems with the other boundary conditions are considered and, finally, the diffusely reflected intensity in a semi-infinite, inhomogeneous atmosphere is derived. It is equal to the intensity yielded by Sobolev. An extension of the Chandrasekhar invariance method was used to obtain the angular distributions of the reflected and the transmitted light in a finite plane-parallel inhomogeneous atmosphere illuminated by axially symmetric radiation at the surfaces $\tau = \tau_0$ and $\tau = \tau_1$ ($\tau_0 \leq \tau \leq \tau_1$), respectively. The intensities are expressed in terms of four functions: a scattering-transmission pair for each of the two boundaries of the atmosphere, because of their polarity. They are new besides those in the limit $\tau_0 = 0$ provided by Bellman and Kalaba and in the text, respectively. Half the integral equations for the above functions correspond to the functional relations for the reflectance and transmittance operators given by Preisendorfer. (auth)

7939 ON THE QUESTION OF BALL LIGHTNING. Paul A. Silberg (Melpar Inc., Watertown, Mass.). J. Appl. Phys. 32, 30-5(1961) Jan.

The hypothetical model of ball lightning suggested by Kapitza is considered to uncover evidence which will substantiate or contradict the theory. Reports of the phenomenon are summarized. Arguments concerning Kapitza's scheme are given. A theoretical model in an ideal environment is examined. The radio-frequency field suggested by Kapitza is considered, and the interference effects resulting from the reflection of a discrete band spectrum of linearly polarized waves from a perfect reflector are presented. The gaseous discharge is discussed, under the assumption that the ball lightning phenomenon is analogous to a point-to-plane corona discharge. It is determined that, given a sufficiently intense electric field, a horizontal discharge along one of the electric field antinodes, suggestive of horizontal lightning, can result. It is concluded that this work supports Kapitza's hypothesis, but that more must be done before the theory is fully substantiated. (auth)

7940 GAMMA RADIATION FOLLOWING RESONANT PROTON CAPTURE BY CHLORINE. J. C. Lisle and P. F. D. Shaw (Clarendon Lab., Oxford, England). Proc. Phys. Soc. (London) 76, 929-38(1960) Dec.

Eleven resonances were observed in the yield of γ radiation produced by the bombardment of chlorine with protons of energies of 500 to 1000 kev. These were assigned to their parent isotopes either by the use of isotopically enriched targets or from the γ rays emitted. The decay schemes of six capture states of Ar^{36} were studied and interpreted in terms of bound states at 1.97, 4.17, 4.45, 4.94, 5.85, and 6.85 Mev. Angular distribution measurements confirmed that the spin of the 4.17 Mev level is 3; from the modes of decay, tentative spin and parity values were assigned to other levels. (auth)

7941 ON THE RADIATION OF NOVA. [PART] I. V. G. Gorbatskiĭ. Vestnik Leningrad. Univ. 15, No. 1, Ser. Mat. Mekh. i Astron. No. 1, 142-51(1960). (In Russian)

An outflow of matter from Nova begins after the outthrowing of the envelope. The ejected gas overtakes the envelope, and kinetic energy of the gas is partially transformed into radiation in the collision process. The energy radiated in this process and the total mass of the ejected gas were calculated for seven Novae. The radiation at the expense of the kinetic energy of the gas is found to form a considerable part of the total radiation of the star during the light-maximum and some time after it. The collision of the envelope with the gas is found to play an important role in the premaximum spectrum transition of Nova to the principal one. (auth)

Cosmic Radiation

7942 (NASA-TN-D-665) THE ION-TRAP RESULTS IN "EXPLORATION OF THE UPPER ATMOSPHERE WITH THE HELP OF THE THIRD SOVIET SPUTNIK." Elden C. Whipple, Jr. (National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.). Jan. 1961. 7p. OTS.

In interpreting the ion-trap data obtained from Sputnik III, unexpectedly high electron temperatures were computed by Krassovskii. It was concluded, on the basis of experimental current-voltage characteristics of the collector, that the effective electron temperature at an altitude of 795 km was not less than 15,000°K, corresponding to a vehicle potential of −6.4 volts with respect to the plasma. If, however, it is noted that a retarding potential corresponding to the average kinetic energy will stop only about half the incident ions, new values of 8800°K and −3.9 volts, respectively, are obtained. (auth)

7943 (NP-9745) PRIMARY AND SECONDARY COSMIC RADIATION NEAR THE GEOMAGNETIC EQUATOR. Laurence E. Peterson (Minnesota. Univ., Minneapolis. School of Physics). Oct. 1960. 121p. Contract Nonr-710(19). (CR-30)

In order to determine the azimuthal effects of primary cosmic-ray protons and α particles near the geomagnetic equator, a large cosmic-ray telescope at a 60° zenith angle was flown on a high altitude balloon near Guam. The telescope was provided with a Čerenkov detector and a scintillation counter in order to resolve events caused by various primary and secondary cosmic rays. The telescope had a geometry factor of 44 cm^2-steradian, represented 21 g/cm^2 of absorbing power, and was arranged to survey azimuth directions. A successful flight of 3-hr duration at 11.5 g/cm^2 balloon depth was obtained during the 1957 cosmic-ray expedition to Guam. Although α particles were not well enough resolved to provide a flux measurement, the exponent of a power law integral number-energy spectrum could be obtained from the East-West asymmetries and geomagnetic theory. The spectrum exponent was found to be at least as large as 1.2. The secondary splash albedo flux was measured to be 20 ± 5 p/m^2-steradian-sec, and the flux of slow protons in the energy range 160 to 600 Mev was found to be 27 ± 5 p/m^2-steradian-sec at a balloon depth of 11.5 g/cm^2 and a 60° zenith angle. A residual slow proton flux of 15 ± 6 p/m^2-steradian-sec at zero depth was observed. The secondary albedo and slow proton fluxes were observed to have a small tendency to peak in the East-West plane. The East-West asymmetries of the minimum ionizing flux, averaged over a 45° azimuth sector, were found to be 0.61 ± 0.13, as compared with the 0.45 ± 0.09 value obtained for asymmetry of the total flux. These values are in considerable disagreement with the 1.22 value predicted from vertical telescope measurements and geomagnetic theory. Considerable evidence for an easily absorbed, isotropically produced, relativistic secondary component, thought to be electrons or mesons, was found at 11.5 g/cm^2. The asymmetry of the proton flux, when corrected for the secondary component, was found to be 1.14 ± 0.18. The proton flux extrapolated to the top of the atmosphere was found to be 115 ± 20 p/m^2-steradian-sec. The azimuth direction of arrival of the maximum flux at Guam was found to be consistent with a simple dipole model of the earth's magnetic field. Considering higher-order field terms does not change the result, since their effect at Guam is small. (auth)

7944 MEASUREMENTS OF COSMIC RADIATION FOLLOWING THE SOLAR FLARE OF MAY 4, 1960. B. Trumpy and T. Svanes. Arbok Univ. Bergen, Mat.-Naturv. Ser. No. 16, 3-9(1960).

Investigations were made of a cosmic-ray increase following a solar-flare of May 4, 1960. Results are given for the nuclear component, the total radiation, and the meson component. The results are compared with corresponding results from a Swedish station and some U.S.A. stations regarding the size of the increase and its time of appearance. (auth)

7945 EFFECTS OF DIFFUSION OF ELECTRONS NEAR THE MAGNETIC EQUATOR. V. C. A. Ferraro, J. E. C. Gliddon, and P. C. Kendall (Queen Mary Coll., London). Nature 188, 1017-18(1960) Dec. 17.

Various theories are discussed of the effect of vertical diffusion in the inosphere in the presence of the geomagnetic field on electron density. It is assumed that the ionization is produced according to the Chapman law and the rate of ionization increases as the magnetic equator is approached. The two effects therefore tend to cancel each other, and the increase in ionization at lower geomagnetic latitudes exceeds any decrease due to other effects. A graph is presented which shows the variation of electron density with geomagnetic latitude about an hour after midday at heights of 0.5, 1, and 1.5 scale heights above the level of maximum ion production. This figure shows that the variation of electron density at midday is rather insensitive to changes of geomagnetic latitude. (C.H.)

7946 THE ANOMALOUS SCATTERING OF UNDERGROUND μ-MESONS. R. Burnstein, T. Kitamura, and D. D. Millar (Univ. of Sydney). Nuclear Phys. 19, 665-74 (1960) Dec. (2). (In English)

A magnet cloud chamber and a multiplate chamber were used to investigate the scattering of underground μ mesons of momentum <1.5 Bev/c in iron and in lead. No evidence was obtained for or against the existence of anomalous large-angle scattering. A computation of the effects of errors, as determined experimentally, on the theoretical scattering distributions indicated that these could easily

simulate an apparent anomaly if not taken into account and that when they are taken into account the possibility of distinguishing between scattering from an extended nucleus and from a point nucleus becomes remote. (auth)

7947 OBSERVATIONS OF EXTENSIVE AIR SHOWERS NEAR THE MAXIMUM OF THEIR LONGITUDINAL DEVELOPMENT. J. Hersil (Universidad Mayor de San Andres, La Paz, Bolivia), I. Escobar, D. Scott, G. Clark, and S. Olbert. Phys. Rev. Letters 6, 22-3(1961) Jan. 1.

Extensive air showers were studied at an altitude of 4200 m with an array of 11 scintillation detectors, and ~400 showers with sizes $>15 \times 10^6$ particles were selected for detailed analysis. The function used in the analysis was the Greisen representation of the Nishimura-Kamata function. The ratios of the observed particle densities to the densities calculated from the trial function were plotted vs. distance from the core; the graphs indicate that the steepness of the lateral distribution decreases with the zenith angle. The integral intensities S of showers with sizes greater than N were then plotted vs. sec θ, and it is found that S for N near 30×10^6 is approximately constant for changes in sec θ near sec $\theta = 1$, corresponding to maximum longitudinal development of showers with N $\sim 30 \times 10^6$. A graph presenting the variation of N with x (slant thickness of atmosphere) at fixed S is also presented. (D.L.C.)

7948 THE COMPOSITION OF THE PRIMARY COSMIC RADIATION. C. J. Waddington (University of Bristol, England). p.1-45 of "Progress in Nuclear Physics. Vol. 8." New York, Pergamon Press, 1960.

A review of data on the composition of primary cosmic radiation is presented in which protons, helium nuclei, and nuclei heavier than helium are treated in detail. The effects of cosmic abundance (calculated from earth, meteorite, and star abundances), geomagnetic field, and temporal variations on cosmic-ray composition are discussed. The extrapolation of data on the heavier nuclei to the top of the atmosphere is considered. A table of the best values for the fluxes of the radiation components at a cutoff rigidity corresponding to Texas or northern Italy is presented together with a discussion of the future prospects for cosmic ray measurements. 122 references. (D.L.C.)

7949 DEVICE FOR PRODUCING A HIGH INTENSITY ARC DISCHARGE. (to United States Atomic Energy Commission). British Patent 858,734. Jan. 11, 1961.

A device for establishing an intense d-c carbon arc of current above 100 amp is designed which has spaced carbon anode and cathode electrodes mounted in a vacuum enclosure. In operation, argon gas is fed to the cathode face, a r-f source is connected between the electrodes until an arc is struck, and the arc is maintained by a parallel magnetic field of 500 to 10,000 gauss. Drawings are included illustrating this device and its application to breakup of molecular ions for thermonuclear reactions. (D.L.C.)

Criticality Studies

7950 (AEEW-R-45) A MONTE CARLO PROGRAM FOR CALCULATING HIGH ENERGY SPECTRA IN CYLINDRICAL GEOMETRY ON THE IBM 709 COMPUTER. S. Francescon (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Establishment, Winfrith, Dorset, England). Oct. 1960. 23p.

An IBM-709 program was written to obtain high-energy spectra in a system containing a number of fissile and non-fissile materials, arranged as concentric cylinders of infinite length surrounded by an outer material with a square or rectangular boundary. (W.L.H.)

7951 (UCRL-6105) THE KUKLA PROMPT CRITICAL ASSEMBLY. Hazards Summary Report. Eugene R. Christie and Brian W. Mar (California. Univ., Livermore. Lawrence Radiation Lab.). Feb. 24, 1960. 84p. Contract W-7405-eng-48.

The Kukla assembly is a bare spherical oralloy assembly capable of producing self-limiting prompt critical fission bursts. Design and theory of operation are to a large extent based on the Godiva assemblies. The assembly was constructed to meet specific physics experimental requirements at the Lawrence Radiation Laboratory, Livermore. It is expected that the assembly will also find use as a source of fast neutrons in irradiation experiments. The assembly will be located in an existing concrete assembly vault. Reactivity assembly rates and amounts are designed to preclude a damaging excursion. In the unlikely event of a major excursion, it is well within the capabilities of the assembly vault to contain the effects of a 10^{18} fission accident. This accident is several times that which could be envisioned under any unfortunate series of events. No undue hazard or exposure to radioactivity would occur to either operating personnel or the civilian population as a result of such an accident. (auth)

Elementary Particles and Radiations

7952 (JINR-D-564) THE INTEGRAL EQUATION FOR THE LOW ENERGY π N-SCATTERING. H. Y. Tzu (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1960. 23p.

A set of coupled integral equations for the low-energy pion-nucleon S- and P-wave scattering amplitudes is derived by using the forward and backward scattering dispersion relations only together with the unitary condition. The contribution from the cut in the unphysical region is taken into account without using analytic continuation by the Legendre expansion. The N-$\tilde{N}$ annihilation reaction amplitudes appear in the integral equations and represent explicitly the effect of the $\pi\pi$-interaction. (auth)

7953 (JINR-D-580) PHOTOPRODUCTION OF PIONS ON PIONS. L. D. Solov'ev (Solovyov) (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1960. 16p.

An exact solution was found for the equation describing the photoproduction of pions on pions at low energies. A requirement choosing a unique solution was formulated. The solution is determined by the high-energy singularities of the amplitude. It has a resonance character, if there is a resonance in pion-pion scattering, in the state with J = I = 1. (auth)

7954 (JINR-D-585) ON THE COMPLETE SET OF EXPERIMENTS ON THE DETERMINATION OF THE AMPLITUDE RATIOS OF PIONS PRODUCTION BY NUCLEONS IN DIFFERENT ISOTOPIC SPIN STATES. K. S. Marish and L. M. Soroko (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Nuclear Problems). 1960. 16p.

A complete set of experiments is discussed which concern the determination of the amplitude ratios of pion production by nucleons in different isotopic spin states. The number of experiments carried out up to now at 660-

Mev nucleon energy is inadequate to determine all the ratios between the amplitudes. One of the experiments discussed can be a sensitive test on the correctness of the resonance theory of π-meson production by nucleons. (auth)

7955 (JINR-D-589) ON BREMSSTRAHLUNG OF LOW ENERGY QUANTA IN ELECTRON PROTON SCATTERING. S. M. Bilenkii (Bilenky) and R. M. Ryndin (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1960. 14p.

The bremsstrahlung of low energy γ quanta in e-p scattering is treated. It is shown that the first two terms of the amplitude expansion in powers of the photon energy are expressed in terms of the electromagnetic form-factors of a proton. The differential cross section for the process was obtained in this approximation. (auth)

7956 (JINR-D-598) PHASE-SHIFT ANALYSIS OF P-P-SCATTERING AT 95, 150 AND 310 MEV. I. M. Gelfand, A. F. Grashin, L. N. Ivanova, I. Ya. (J.) Pomeranchuk, and Ya. (J.) A. Smorodinskii (Smorodinsky) (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1960. 12p.

Presented at the Xth Conference on High Energy Physics, Rochester, 1960.

When experimental data are insufficient, the phase-shift analysis yields as a solution rather large and complicated regions that cannot be described by indicating the local minima and error matrices. The limits for possible values of the phase shifts obtained earlier by the generally accepted procedure are underestimated. A modified analysis does not reduce the multiplicity of the solution and does not allow a decrease of the number of necessary experiments, but it leads to a certain decrease of the permissible regions weakening thereby the requirements to the accuracy of experimental points. Smoothing the goodness-of-fit curves, allows a restriction to the measurements of a small number of scattering angles. Regions N1 at different energies are the continuation of one another; the same may be said about regions N2. Solutions 5 to 8 and 7 for 310 Mev, when continued to lower energies, vanish and fail to give new regions. This indicates that these regions do not contain real solutions et al. Solution N1, at 95 Mev, yields the values for ^3P phase shifts, close to the one-pion and the positive S^1 phase shift. This corresponds to the sign of the ^1S phase shift in the region of effective range approximation. Solution N2 does not possess these properties. The available data allow a distinction of weakly peripheral phase shifts corresponding to the impact parameters $r_0 \sim (\lambda/\mu)$ (D and F phase shifts at 150 Mev). These phase shifts are in qualitative agreement with the theoretical ones, however, at the present time it is impossible to make quantitative comparison. (auth)

7957 (NYO-9542) A NON-LINEAR THEORY OF ELEMENTARY PARTICLES. Hans-Peter Duerr (Rochester, N. Y. Univ.). Aug. 1960. 33p. Contract AT(30-1)-875. OTS.

A general outline of a nonlinear theory of elementary particles is given. The Heisenberg-Pauli differential equation, calculations of mass eigenvalues, approximate calculation of the propagator function, and space-reflection symmetry are discussed in some detail. (W.D.M.)

7958 (ORNL-3033) ELECTROMAGNETIC PRODUCTION OF PION PAIRS. C. D. Zerby (Oak Ridge National Lab., Tenn.). Jan. 17, 1961. 111p. Contract W-7405-eng-26. OTS.

This study of the Pauli-Weisskopf theory of pair production in the experimentally attainable region just above threshold is a result of the suggestion that the electromagnetic production of pion pairs may be a possible way of investigating the π-π interaction. The Pauli-Weisskopf theory was investigated with the objective of including the strong pion-nucleus interaction in the form of a complex optical potential as a means of determining the increase in the cross section resulting from this interaction. It was found that the potentials could be included in the field equations in a consistent manner that would lead to the absorption and scattering of the pions after production if the real part of the potential were a world scalar and the imaginary part the time component of a four-vector. The matrix element for pair production was obtained by using exact waves that were expanded into angular momentum states, and numerical calculations were performed to examine the effect of a nuclear charge distribution and nuclear potential on the cross section. In the region just above threshold, it was found that the cross section for lead with a charge distribution of the form obtained from electron scattering experiments was approximately a factor 10^{-4} smaller than that obtained with a point charge nucleus and that this reduction in the cross section was regained when a nuclear optical potential was included that has a depth consistent with pion scattering experiments. The calculations show that the cross section for lead with a charge distribution and nuclear optical potential increases slowly just above threshold until approximately 295 Mev, where it starts to increase almost linearly, attaining a value of 1.07×10^{-32} cm^2 at 310 Mev. (auth)

7959 (ORO-343) IONIZATION AND CHARGE TRANSFER CROSS SECTIONS. Technical Status Report No. 5, Covering Period September 1, 1960–November 30, 1960. E. W. McDaniel, D. W. Martin, and J. W. Hooper (Georgia Inst. of Tech., Atlanta. Engineering Experiment Station). 10p. Project No. B-176. Contract AT(40-1)-2591.

Measurements of the gross ionization cross sections for protons incident on nitrogen gas from 0.15 to 1.10 Mev were completed. The data follow a straight line in a log-log plot throughout the energy range. The data are represented by the following expression: $\sigma_i = (1.42 \pm 0.09)\, E^{-(0.711 \pm 0.011)} \times 10^{-16}$ cm^2/molecule, where E is the kinetic energy of the incident proton in Mev. (W.L.H.)

7960 (TID-6762) TESTS OF FORM OF THE ONE-PION EXCHANGE POTENTIAL. G. Breit, M. H. Hull, Jr., K. E. Lassila, and H. M. Ruppel (Yale Univ., New Haven). [1960]. 18p. Contract AT(30-1)-1807. OTS.

The mathematical form of the one-pion exchange potential (OPEP) is tested by comparison with experimental material on nucleon-nucleon scattering. The tests are performed by modifying the form following from meson theory through changes in the proportions of spin-spin and tensor parts of the potential and also by adding a central potential part. These two tests are performed independently of each other, and in each case the pion-nucleon coupling constant is allowed to vary simultaneously with the modifying parameter. Proton-proton and proton-neutron data are treated independently of each other. The experimental material is in the region from about 9 to 340 Mev. Within the statistical error of the determination of best values of the parameters they are not significantly different from zero as long as the conditions for the applicability of the OPEP are satisfied through exclusion of too low values of orbital angular momentum Lh. A definite deviation appears in tests of the central potential when L = 4 is admitted in the OPEP group of singlet even potentials. The absence of a definite effect for the proportion of spin-spin and tensor

parts in tests performed fits expectation for the two-pion exchange potential. (auth)

7961 (UCRL-6099) CROSS SECTIONS AND SPECTRA FOR NEGATIVE ELECTRON BREMSSTRAHLUNG. N. E. Hansen and S. C. Fultz (California. Univ., Livermore. Lawrence Radiation Lab.). Nov. 15, 1960. 38p. Contract W-7405-eng-48.

Cross sections, photon spectra, intensity spectra, energy losses in collision and radiative processes, and the efficiency for the production of bremsstrahlung are presented for thin targets of Al, Sn, W, Pb, and U. An estimate is made of the photon spectra and bremsstrahlung efficiency for targets with thicknesses of the order of the range of the primary electrons in these materials. The data are derived for initial electron energies from the low relativistic range up to 35 Mev. (auth)

7962 (UCRL-9362) DIFFERENTIAL ELASTIC PION–PROTON SCATTERING AT 600, 650, AND 750 MEV (thesis). John I. Shonle (California. Univ., Berkeley. Lawrence Radiation Lab.). Aug. 12, 1960. 70p. Contract W-7405-eng-48.

The differential elastic cross sections for π^--p scattering were measured at 610 ± 20, 655 ± 20, and 750 ± 20 Mev in a propane bubble chamber. The elastic events were selected by a χ^2 test. The total elastic cross sections are 17.7 ± 2.3, 16.6 ± 1.4, and 14.8 ± 1.4 mb, respectively. Cosine-power series were fitted to the angular distributions. The variation of the coefficients with energy indicates $J = 3/2$ for the 600-Mev resonance and $J = 5/2$ for the 890-Mev resonance in the π^--p interaction. The data were more compatible with odd relative parity for the two: $P_{3/2}$ and $D_{5/2}$ or $D_{3/2}$ and $F_{5/2}$. Thus the scattering data independently give the same assignments for the peaks as the photoproduction data. Resonance at the peaks is not established but is the most plausible explanation for them. Strong absorption of the $J = 3/2$ resonant wave is suggested. (auth)

7963 (USNRDL-TR-461) TRANSMISSION AND SCATTERING PROPERTIES OF A NEVADA DESERT ATMOSPHERE UNDER CLOUDY CONDITIONS. M. G. Gibbons, F. I. Laughridge, J. R. Nichols, and N. A. Krause (Naval Radiological Defense Lab., San Francisco). Aug. 9, 1960. 34p. (DASA-1192)

The angular scattering diagram of a desert atmosphere was measured for radiation at 0.40, 0.45, 0.50, and 0.55μ wavelength, and attenuation coefficients for scattering and absorption were determined in the same atmosphere for radiation at 0.40, 0.50, 0.70, and 0.83μ wavelength. All these measurements were made under both clear-sky and cloudy conditions and with source-receiver distances D ranging from 1.07 to 17.15 miles. The ratio of scattered-in to direct radiation received from a 4-π source was also measured for wavelengths at 0.40, 0.50, 0.70, and 0.83μ for the same values of D, and for receiver fields of view ranging from 4 to 64° half-angle, both with and without cloud cover. By extrapolation of the results to the case of a receiver with field of view of 90° half-angle, attenuation coefficients for aureoled transmission from a 4-π source to a flat receiver facing the source and ratios R of scattered-in to direct radiation received by such a receiver were determined for these wavelengths. Plots of R vs. D are presented which show that under conditions of little or no cloud cover (and in winter) R for each of the four wavelengths increases monotonically with D out to a distance of 17.15 miles, whereas for the case of full overcast at 4000 ft above ground, R increases with D for distances up to about 10 miles and then decreases with increasing distance at least for the next few miles. For lower cloud height the maximum in R appears to move to smaller distances, approximately in proportion to cloud height. (auth)

7964 THE LIFETIME OF HYPERFRAGMENTS. G. C. Deka (Cotton Coll., Gauhati, India). Indian J. Phys. 34, 470-4(1960) Oct.

Available data on the time-of-flight of hyperfragments were used to deduce a lifetime for light hypernuclei. The value obtained is discussed. (auth)

7965 RELATIONSHIP BETWEEN SYSTEMS OF IMPENETRABLE BOSONS AND FERMIONS IN ONE DIMENSION. M. Girardeau (Brandeis Univ., Waltham, Mass.). J. Math. Phys. 1, 516-23(1960) Nov.-Dec.

A rigorous one-one correspondence is established between one-dimensional systems of bosons and of spinless fermions. This correspondence holds irrespective of the nature of the interparticle interactions, subject only to the restriction that the interaction have an impenetrable core. It is shown that the Bose and Fermi eigenfunctions are related by $\psi^B = \psi^F A$, where A $(x_1 \ldots x_n)$ is +1 or −1 according as the order pq ... r, when the particle coordinates x_j are arranged in the order $x_p < x_q < \ldots < x_r$, is an even or an odd permutation of 1 ... n. The energy spectra of the two systems are identical, as are all configurational probability distributions, but the momentum distributions are quite different. The general theory is illustrated by application to the special case of impenetrable point particles; the one-one correspondence between bosons with this particular interaction and completely noninteracting fermions leads to a rigorous solution of this many-boson problem. (auth)

7966 THEORETICAL MAGNETIC MOMENTS OF PROTON AND NEUTRON. K. M. Guggenheimer (Univ. of Glasgow). Nature 188, 1014-16(1960) Dec. 17.

Recently it was shown that the equation $E = 38.46\ [I(I + 1) + s(s + 1)]$ Mev provides a correlation of empirical particle masses and of nucleon excitations. The prediction of a resonance energy E_r at 750 Mev in free protons has now been fully confirmed. The maximum for π^+ scattering reported to lie at 1.3 or 1.35 Mev appears to be a doublet. Tabulated data are presented on the energies for the transitions from the core particle $^2F_{7/2}$ to the indicated higher levels, and the energies needed for the formation of pairs, all calculated according to this equation. The observed resonance energies in photoproduction and scattering of pions from free protons are included. This equation provides a numerical interpretation of all observed resonance energies. The agreement is in several cases within 1 per cent, less than the estimated error. This equation also contains quantum numbers which are essential for calculating the magnetic moments of the proton and the neutron. In particular, the state $^6F_{7/2}$ plays an important part as the core particle of the proton. Theoretical magnetic moments of the proton and neutron are discussed. (C.H.)

7967 ASYMMETRY PARAMETER OF Λ DECAY AND THE INTERMEDIATE BOSON OF WEAK INTERACTIONS. S. Oneda (Kanazawa Univ., Japan) J. C. Pati, and B. Sakita. Phys. Rev. Letters 6, 24-6(1961) Jan. 1.

The implications of the sign of the α^- asymmetry parameter which has not yet been definitely settled for the $\Lambda^0 \rightarrow p + \pi^-$ decay are discussed for the four-fermion interaction. It is concluded that a positive sign for α^- would favor a local four-fermion interaction, whereas a negative

sign would favor the interaction being mediated by a vector boson. (D.L.C.)

7968 TEST FOR K^--HYPERON RELATIVE PARITY. B. A. Jacobsohn and R. M. Ryndin (European Organization for Nuclear Research, Geneva). Phys. Rev. Letters 6, 27-9(1961) Jan. 1.

A test for K^--Λ and K^--Σ parity using K^- stopped in an unpolarized target is outlined for helium on the basis of Sirlin and Spitzer's experiment, which is independent of any special assumptions on K absorption other than conservation of parity and zero K spin. The test is considered in general terms for the reaction $K^- + He^4 \rightarrow$ any number of particles, the particles having parallel or antiparallel relative momenta. The test is then related to the (K^-,d) atom. Applications of the test in the reactions $K^- + He^4 \rightarrow {}_\Lambda H^4 + \pi^0$; ${}_\Lambda H^4 \rightarrow He^4 + \pi^-$ and as a detector of nuclear alignment in $X(d,\alpha)Y^*$ where X and Y^* are both 0^+ states are next discussed. (D.L.C.)

7969 $N\bar{N} \rightarrow \pi\pi$ AMPLITUDE AND THE ELECTROMAGNETIC STRUCTURE OF THE NUCLEON. James S. Ball and David Y. Wong (Univ. of California, La Jolla). Phys. Rev. Letters 6, 29-31(1961) Jan. 1.

The $N\bar{N} \rightarrow \pi\pi$ amplitude is normalized using the π-N fixed momentum transfer dispersion relations in the neighborhood of zero momentum transfer and a two-pole P-wave effective range formula to represent the π-π P-wave resonance. Some of the functions in the equation for the amplitude are expressed in terms of π-N phase shifts. Tables of Γ amplitudes are given with no subtraction and with one subtraction at the π-N threshold and are used to calculate the isovector part of the nucleon form factors. The improvements of the calculations over those of Frazer and Fulco and their remaining limitations are discussed. (D.L.C.)

7970 ELECTROMAGNETIC MESON MASS DIFFERENCES. D. J. Hall (Queen Elizabeth Coll., London). Phys. Rev. Letters 6, 31-3(1961) Jan. 1.

It is shown that if the π and K meson electromagnetic mass differences are calculated in the finite electromagnetic gage, the two-photon vertex term becomes finite in the pole approximation to the dispersion relation and a satisfactory quantum theory of both π and K meson mass splitting is obtained. An equation is derived for the mass difference between π^+ and π^0 mesons, which gives a result agreeing with experiment; and the equation for K^+ and K^0 mesons gives a mass difference of -3.5 Mev, corresponding to a K meson model of a positively charged cloud of radius $\sim 0.5 \times 10^{-13}$ cm with a negatively charged core of radius $\sim 0.2 \times 10^{-13}$ cm. (D.L.C.)

7971 SOLUTION OF THE SCHROEDINGER EQUATION IN A CONSTANT MAGNETIC FIELD AND DIAMAGNETISM. N. Minnaja (Università, Pisa, Italy). Physica 26, 827-33(1960) Oct.

The Schroedinger equation for charged particles without spin in a cylindrical box and subject to a constant magnetic field is solved exactly. The energy eigenvalues are determined, and the results are compared with those of Landau for the diamagnetism of a gas of charged particles. (auth)

7972 ON POTENTIAL SCATTERING OF RELATIVISTIC PARTICLES. F. Prats (Univ. of Birmingham, Eng.). Proc. Roy. Soc. (London) A259, 403-8(1960) Dec. 29.

The S-matrix for the problem of potential scattering of relativistic particles can be expressed in terms of resonance states under restrictions on the potential which are similar to those of the nonrelativistic case. The S-matrix is a double-valued function of momentum or energy with branch points as given by the relativistic energy-momentum relation. (auth)

7973 INFLUENCE OF A SPACE CHARGE ON ELECTRON KINETICS IN A LONGITUDINAL MAGNETIC FIELD. M. N. Vasil'eva and E. M. Reĭkhrudel (Moscow State Univ.). Radiotekh. i Elektron. 5, 2065-8(1960) Dec. (In Russian)

An analysis was made of electron motion in a longitudinal magnetic field, H, and in a heterogeneous axially-symmetric electric field where the distribution of potential is described by the functions $\phi(z)$ and $\phi(r)$ with considerations for space charges. The solution is developed for a potential distribution curve with only one maximum. (R.V.J.)

7974 RESONANCE SCATTERING OF γ RAYS IN CRYSTALS. G. N. Belozerskii and Yu. A. Nemilov. Uspekhi Fiz. Nauk 72, 433-66(1960) Nov. (In Russian)

A review is given of the various aspects of γ resonance scattering in crystals. The capture of slow neutrons by atoms in a crystal lattice, the applications of the Lamb theory in γ resonance scattering, the application of temperature variations in the source, mechanical motion of the source in relation to the absorber in resonance absorption, and hyperfine splitting and polarization in experiments with resonance scattering are studied. The effects of resonance absorption in solids, the verification of the general theory of relativity, and the limitations of the γ-ray resonance absorption method are discussed. 95 references. (R.V.J.)

7975 TREATING OF BOUND STATES IN THE CLOTHED PARTICLE THEORY. M. A. Braun. Vestnik Leningrad. Univ. 15, No. 4, Ser. Fiz. i Khim. No. 1, 26-32 (1960). (In Russian)

The problem of bound states in field theory is studied by the clothed particle technique. The formulas that allow the matrix elements in problems involving bound states to be reduced to one particle matrix elements are obtained without considering the vacuum polarization. As an example, the pion-deuteron scattering is considered. (auth)

7976 CALCULATION OF THE PION-NUCLEON SCATTERING PHASES FROM DISPERSION RELATIONS. I. G. Höhler and K. Dietz (Technische Hochschule, Karlsruhe). Z. Physik 160, 453-72(1960). (In German)

The small pion-nucleon scattering phase shifts were calculated by Chew, Goldberger, Low, and Nambu, using relativistic dispersion relations and the data of the first resonance. The authors introduced several approximations without going into the details of their validity. It is the aim of this paper to give a more accurate treatment because it turned out that the approximations used by Chew et al. result in pretty large errors, at least for the s-waves. First retain the neglect of all contributions to the dispersion integral other than the 33-part and consider the s-wave amplitude Re $f_s^{(-)} = (\sin 2\alpha_1 - \sin 2\alpha_3)/6q$. For 200-Mev (lab.) pions, the correct evaluation of the recoil effects leads to a value 2.8 times lower than the 1/M approximation and the projection, carried through without an approximation, deviates by 20% from the first terms of the expansion used by CGLN. At zero kinetic energy, a comparison with the dispersion relation for forward scattering shows that the neglected contributions to the dispersion integral amount to $35 \pm 15\%$. The combination of the s-phases was recalculated, replacing the first two approximations of CGLN by an exact treatment. In order to take care of the main part of the neglected contributions to the dispersion integral, the value found at zero kinetic

energy was added. The energy dependence, not accounted for by this procedure, should result in a one-sided deviation from the experimental data. Comparison with these data, however, shows that the absolute values as well as the energy dependence of the calculated curve agree reasonably with the measurements up to 333 Mev. Cini et al. and Hamilton et al. have used an interpolation formula which represents the measured s-wave data by adjusting parameters, whereas in this paper the combination of s-phases is calculated from α_{33} and σ_{tot}. The result for the s-wave scattering lengths $a_1 - a_3 = 0.255$ is compatible with P = 1.60 for the Panofsky ratio and with the measured photomeson cross section, which near threshold shows no deviations from the perturbation theoretical values for charged pions ($f^2 = 0.080$). It is doubted that in this energy region the small additional contributions, which follow from the dispersion theory of photoproduction in its present state, are really an improvement of the perturbation theoretical results. The scattering lengths of the p-waves were calculated, taking into account only the 33-part of the dispersion integral but without the recoil approximation of CGLN ($f^2 = 0.080$): $a_{33} = 0.189$, $a_{13} = -0.045$, $a_{13} - a_{31} = 0.0007$, $a_{11} = -0.147$. The formulas for these scattering lengths and the corresponding q^2-coefficient of the s-wave amplitude fulfill Geffens relation identically if the total cross sections occurring in the integral are replaced by their 33-parts. This changes the value of the integral by 5 to 10%. The approximations of Chew et al. were used in the discussion of the influence of the π-π interaction on the π-N scattering phase shifts. The result makes it worthwhile to reconsider this question. (auth)

7977 PHOTON-ELECTRON CORRELATIONS IN DOUBLE COMPTON SCATTERING. T. K. Radha and R. Thunga (Univ. of Madras). Z. Physik 161, 20-5(1961). (In English)

The exact matrix element for the production of two circularly polarized photons in double Compton scattering when the initial photon is also circularly polarized is calculated. The differential cross sections for the various photon-electron polarization correlations are obtained for high energy photons, i.e., taking only near forward emission of photons. It is found that irrespective of the spin of the initial electron, the cross section for either right or left circular polarization of all three photons is zero under this approximation. (auth)

7978 MEASUREMENT OF THE CIRCULAR POLARIZATION OF INTERNAL AND EXTERNAL BREMSSTRAHLUNG. S. Galster (Universität, Mainz). Z. Physik 161, 46-61(1961). (In German)

The polarization of the internal bremsstrahlung γ's was detected by Compton-forward-scattering with polarized electrons for three β-decays: (1.) for the allowed transition (P^{32}), (2.) for the unique forbidden transition ($Sr^{90} + Y^{90}$), and (3.) for the forbidden transition with forbidden spectrum (Bi^{210} = RaE). The detected polarization values of P^{32} and ($Sr^{90} + Y^{90}$) agree with theoretical values for the allowed transitions. The detected polarization values for Bi^{210} are smaller than the theoretical values of the allowed β-transition by a factor of 0.62 ± 0.08. The polarization of the external bremsstrahlung was measured as a function of the atomic number (Z) using thick absorbers, and it decreases slowly with the increase of the atomic number. The polarization, extrapolated to an absorber with atomic number Z = 0, is in good agreement with theoretical values of the infinitively thin absorbers. (auth)

7979 DISPERSION RELATIONS FOR ELEMENTARY PARTICLES. J. Hamilton (Christ's College, Cambridge, England). p.143-94 of "Progress in Nuclear Physics. Vol. 8." New York, Pergamon Press, 1960.

Several examples of dispersion relations are derived for a simple circuit, a transformer, and superconductivity. A dispersion relation for the polarization amplitude of light scattering by an atom and the Kramers-Kronig dispersion relation are derived. The optical theorem and causality are discussed. The basis of the relations are outlined, and relations are derived for the following: field theory (relativistic), forward and nonforward scattering, scattering and adsorption of γ rays by nuclei, pion-nucleon scattering, nucleon-nucleon scattering, and proton-proton scattering. Mandelstam's representation is treated. Comparison is made between theory and experiment. 69 references. (D.L.C.)

7980 THE PHOTOPRODUCTION OF PIONS. E. H. Bellamy. p.237-91 of "Progress in Nuclear Physics. Vol. 8."

The properties of the bremsstrahlung beam and the experimental techniques used in studies of pion photoproduction are discussed, and a review of data on pion photoproduction is presented for nucleons at both $E_\gamma < 450$ Mev and $E_\gamma > 450$ Mev and for nuclei, particularly helium nuclei. Pion production by fast electrons is also considered. 142 references. (D.L.C.)

Neutron Physics

7981 (AERE-R-3443) THE MEASUREMENT OF FAST NEUTRON FLUX USING THE $S^{32}(n,p)P^{32}$ REACTION. B. H. Parker (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Nov. 1960. 38p.

The theoretical and experimental aspects of measuring fast neutron fluxes by means of the $S^{32}(n,p)P^{32}$ reaction are discussed, and recommendations are made on suitable methods for use during the commissioning trials of power reactors. Special attention is given to the problem of measurement in regions of widely varying flux levels such as are encountered in shield surveys. (auth)

7982 (ANL-6254) A PULSED NEUTRON SOURCE TECHNIQUE. R. Siems and M. Melissaropoulos (International School of Nuclear Science and Engineering, Lemont, Ill.). Nov. 1960. 32p. Contract W-31-109-eng-38.

For a measurement of the diffusion constant D from the decay of the fundamental mode only, optimal dimensions of the pile are given, leading to a fast decay of the higher modes. Another method is discussed which makes use also of higher modes. Evaluation formulas and optimal pile dimensions for this method are derived. The amplitudes of the normal modes are calculated for different initial distributions of the neutrons by means of the Fermi age theory. The error introduced using Fermi age theory was fixed moderator atoms for the slowing down process down to thermal energy is estimated. In one instance, for a simple initial distribution of thermal neutrons, the neutron density was calculated as a function of space and time. The data obtained were used to check the accuracy of some approximate evaluation formulas derived here. (auth)

7983 (CF-59-6-37) A REVIEW OF THE MATHEMATICAL FORMULATION OF THE PROBLEM OF INELASTIC NEUTRON SCATTERING BY POLYCRYSTALLINE MATERIAL. C. A. Preskitt (Oak Ridge National Lab., Tenn.). June 5, 1959. 35p.

A self-contained development of the formulation of the

problem of inelastic neutron scattering by crystals is presented. Although nearly all of the methods and results used in the discussion have appeared in a variety of previously published papers, additional mathematical details are given here which were found to aid in understanding the final results. (auth)

7984 (GEAP-3599) BOUNCE III. B. A. Kerr (General Electric Co. Vallecitos Atomic Lab., Pleasanton, Calif.). Dec. 15, 1960. 7p. Contract AT(04-3)-189, Project Agreement No. 4.

BOUNCE III is a program which was written for the IBM-704 as part of a study of the parameters of the neutron distribution in a large thermal column. The program calculates the eigenvalues and corresponding eigenvectors of the matrix resulting from a diffusion-theory, multigroup description of the thermal neutron spectrum. (auth)

7985 (NAA-SR-Memo-5861) CROSS SECTION DATA APPLICABLE TO MONTE CARLO CALCULATIONS. H. Alter (Atomics International, Div. of North American Aviation, Inc., Canoga Park, Calif.). Nov. 9, 1960. 28p.

Selected neutron-cross-section data for use in Monte Carlo determinations of neutron slowing down moments are presented. Data for hydrogen (H-1), carbon (C-12), oxygen (O-16), fluorine (F-19), zirconium (Zr-90), uranium (U-235), and uranium (U-238) are included. (W.L.H.)

7986 (UCRL-6223) ANGULAR DISTRIBUTION OF NEUTRONS FROM A GRAPHITE SURFACE (thesis). Allan Charles Jones, Jr. (California. Univ., Livermore. Lawrence Radiation Lab.). Nov. 14, 1960. 49p. Contract W-7405-eng-48.

Results are presented of measurements of the angular distribution of thermal neutrons from a graphite surface, using a Li^6I scintillation detector and a 4-ft graphite cube. The experimental measurements are compared with theoretical predictions based on the assumption of isotropic scattering in the laboratory system. The results indicate that the assumption of isotropic scattering for thermal neutrons in graphite is reasonably accurate. A 4-ft graphite cube containing a plutonium-beryllium source located at its center provided neutrons for the experiment. All sides of the cube were covered with $\frac{1}{4}$-in. boral plate, except for a small area around the center of one vertical face. This area was covered with a 20-mil thickness of cadmium, which had a 1.5-in.-diameter hole centered on the 4-ft-square face. The 1.5-in.-diameter surface served as a source for the measurements. Thermal neutron count rates were obtained by a "boron-difference" method. The boron-difference count rates are the differences between count rates measured with a Li^6I (Eu)-activated scintillation detector at each angular position with and without boron-containing polyethylene disks placed over the 1.5-in.-diameter graphite surface. The experimental results were found to agree quite well with both the theoretical predictions of Placzek and with spherical harmonic calculations based on isotropic scattering in the laboratory system. (auth)

7987 CHEMICAL BINDING EFFECTS IN THE THERMALIZATION OF NEUTRONS. Noel Corngold (Brookhaven National Lab., Upton, N. Y.). Ann. Phys. (N. Y.) 11, 338-58(1960) Nov. (BNL-4926)

In an earlier paper an asymptotic series solution was extracted in half-integral powers of (kT/E) from the Boltzmann transport equation for neutrons coming into thermal equilibrium with a moderating material. The series is considered for moderators having simple crystalline structure or in which vibrational modes predominate and give the coefficients of the series explicitly in terms of moments of the frequency spectrum of crystal vibrations. The calculations indicate that the neutron density in the asymptotic region increases as the spectrum of crystal vibrations hardens, whence the "hardness" of the neutron spectrum increases, too. Some aspects are discussed of the mass-expansion for these systems, and calculations are compared with those of other workers and with typical experimental data for thermalization in water. The asymptotic expansion for moments of the scattering kernel and for $\xi\sigma_s$, the slowing down power, are discussed. (auth)

7988 DEFINITION OF THE DIFFUSION CONSTANT IN ONE-GROUP THEORY. N. G. Sjöstrand (AB Atomenergi, Stockholm, Sweden). J. Nuclear Energy, Pt. A. Reactor Sci. 12, 151-4(1960).

A one-group transport equation is derived from the general Boltzmann equation with the sole assumption that the neutron velocity spectrum is independent of position and direction. It is shown that with this assumption the correct way to define a diffusion constant is to form averages of the scattering cross section, not the mean free path, over the neutron spectrum. Conclusions are drawn regarding the equivalence between moderator systems studied with pulsed neutron sources and critical reactors and regarding possible systematic differences in diffusion constants derived from stationary and pulsed source experiments. An accurate equation for the neutron spectrum is derived, and finally other approaches to the problem are discussed. (auth)

7989 FAST REACTOR CROSS SECTIONS. A STUDY LEADING TO A 16 GROUP SET. S. Yiftah, D. Okrent, and P. A. Moldauer. International Series of Monographs on Nuclear Energy. Division II. Nuclear Physics. Volume 4. New York, Pergamon Press, 1960. 136p. $5.00.

A new multigroup fast neutron cross section set for many reactor materials is constructed in which all choices and assumptions are explained. Fission, neutron scattering, and neutron capture are treated. The constants are obtained by a review of the experimental data available as of March 1960 and theoretical estimates where data are not available. Gaps, conflicts, and inconsistencies are pointed out. The calculations are compared with critical experiments to give an indication of the agreement between microscopic and integral experiments. (D.L.C.)

Nuclear Properties and Reactions

7990 (CF-59-10-19) EFFECT OF DIFFERENT SETS OF CROSS-SECTIONS ON Cf-252 PRODUCTION IN THE HFIR. H. C. Claiborne (Oak Ridge National Lab., Tenn.). Oct. 8, 1959. 4p.

Production rates of Cf^{252} calculated from neutron cross sections compiled at Berkeley, KAPL, and Argonne were compared with that calculated in CF-59-8-125. In the range of interest, the maximum difference was about a factor of three. The previous estimate of Cf^{252} production rates in the HFIR was shown to be conservative. (auth)

7991 (CF-60-12-38) A STATISTICAL MODEL OF NUCLEAR LEVEL SPACINGS. L. Dresner and E. Inönü (Oak Ridge National Lab., Tenn.). Dec. 4, 1960. 16p.

A generalization of Wigner's simple model for the distribution of nuclear level spacings is studied. The generalization is based on a stochastic process which reproduces the correct joint probability distribution of N

energy levels for small spacings. The case N = 3, which includes the effect of the correlation between adjacent spacings, is discussed in detail. The resulting distribution and the correlation coefficient are compared with experimental data. No definite conclusion can be drawn except that the effect of the correlations on the spacing distribution is very small. (auth)

7992 (GA-1193) MEASURING THE RANGE OF RECOIL ATOMS IN VARIOUS MATERIALS. Status Report No. 1 for the Period October 1, 1959—December 31, 1959. R. A. Schmitt and V. A. J. van Lint (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Jan. 15, 1960. 45p. Project No. 72. Contract AF33(616)-6795.

Recoil atoms from the following reactions were studied: $Ti^{46}(\gamma,n)Ti^{45}$, $Cu^{63}(\gamma,n)Cu^{62}$, $Cu^{65}(\gamma,n)Cu^{64}$, $Zn^{64}(\gamma,n)Zn^{63}$, $Ag^{107}(\gamma,n)Ag^{106}$, $Ag^{107}(\gamma,n)Ag^{106m}$, $Ta^{181}(\gamma,n)Ta^{180m}$, $Pt^{196}(\gamma,n)Pt^{197}$, $Au^{197}(\gamma,n)Au^{196}$, $Ti^{48}(\gamma,p)Sc^{47}$. Pertinent theoretical considerations are described and the techniques and results of each of the three experimental categories mentioned are discussed. (auth)

7993 (KAPL-M-EHA-1) ABACUS 1—PRELIMINARY DESCRIPTION AND INPUT PREPARATION. E. H. Auerbach (Knolls Atomic Power Lab., Schenectady, N. Y.). Dec. 15, 1960. 27p. Contract W-31-109-Eng-52.

The ABACUS system is a digital computer program for the determination of cross sections. It provides for the calculation of wave functions according to the nuclear optical model. From these data it will further give the shape elastic and total cross sections, the elastic and inelastic scattering cross sections according to Hauser-Feshbach theory, and various radial integrals of products of wave functions useful in cross-section evaluations. The program, written for the PHILCO-2000, also contains procedures for determining "best" optical model parameters. (auth)

7994 (NP-9739) STUDIES IN PHOTONUCLEAR REACTIONS. Annual Report. (Pennsylvania. Univ., Philadelphia). Dec. 19, 1960. 7p. Contract AF49 (638)-454.

An intensive study of neutron separation energies inferred from (γ,n) threshold measurements was completed. It was found that the threshold for the reaction $C^{12}(\gamma,n)C^{11}$ occurred at 18.79 Mev. The $N^{14}(\gamma,n)N^{13}$ and $O^{16}(\gamma,n)O^{15}$ reactions were also investigated. (W.L.H.)

7995 (TID-11390) ANALYTICITY IN THE COUPLING CONSTANT AND BOUND STATES IN POTENTIAL THEORY. Technical Report No. 199. B. Bosco (Brookhaven National Lab., Upton, N. Y.) and J. Sucher (Maryland. Univ., College Park). Nov. 1960. 11p. ([AFOSR]-TN-60-1434). OTS.

A method for determining the wave function in potential scattering, from the S-matrix, using unitarity and analyticity, is extended to the case where bound states are present by using analytic continuation in the coupling constant. A numerical example is given, illustrating the passage of a pole from the second Riemann sheet of the energy to the first sheet. (auth)

7996 (UCRL-3587) SINGLE-PARTICLE STATES IN A SPHEROIDAL NUCLEAR POTENTIAL (thesis). Marvin Rich (California. Univ., Berkeley. Radiation Lab.). Nov. 16, 1956. 156p. Contract W-7405-eng-48. OTS.

In order to provide an additional tool for the study of the low-energy properties of highly nonspherical nuclei, a computation of eigenstates was made for a particle moving in a spheroidal potential well under the influence of a strong spin-orbit interaction. The nucleus was regarded as a collection of independently moving particles bound in the same potential well, in a manner similar to the shell model. A simplified nucleon hamiltonian was used. Particles were treated as bound in an isotropic harmonic oscillator potential to which three perturbations were applied. These consist of the spin-orbit interaction, a nonisotropic deformation term, and a truncation term that acts to flatten the bottom of the potential well. Approximate solutions were obtained by an exact diagonalization of those submatrices of the perturbation hamiltonian that connect only harmonic oscillator states within the same major oscillator shell. Eigenvalues and eigenfunction expansion coefficients are presented in tabular form as functions of the deviation of the potential shape from sphericity. To illustrate the applicability of the single-particle eigenstates to nuclear systems, a study was made of the ground-state spins and magnetic moments of a large number of deformed nuclei. A close correlation is shown to exist in most instances between the empirical data and the predicted spins and magnetic moments. (auth)

7997 (UCRL-6177) PHOTONEUTRON CROSS SECTIONS FOR Pb, Ta, AND Be MEASURED BY USE OF PHOTONS FROM POSITRON ANNIHILATION IN FLIGHT. F. D. Seward, S. C. Fultz, C. P. Jupiter, and R. E. Shafer (California. Univ., Livermore. Lawrence Radiation Lab.). Nov. 25, 1960. 24p. Contract W-7405-eng-48. OTS.

A 22-Mev electron accelerator was used in a facility to produce nearly monoenergetic photons at 10 to 17 Mev. The photons were produced from the annihilation in flight of positrons. The positrons were created at the end of the first section of the accelerator by irradiation of a thick tantalum target with 10-Mev electrons and were then accelerated in the second section. Cross sections for photoneutron yields from lead, tantalum, and beryllium were measured and are compared with those obtained by other methods. (auth)

7998 (UCRL-6218-T) PHOTON-INDUCED NEUTRON SPECTRUM FROM URANIUM. Harry N. Kornblum and Stanley C. Freden (California. Univ., Livermore. Lawrence Radiation Lab.). Nov. 8, 1960. 13p. Contract W-7405-eng-48.

An experiment was performed using nuclear emulsions to measure the neutron flux and energy spectrum from a thick uranium target bombarded by 18-Mev electrons. The total integrated flux of 3.6×10^{-4} neutrons per electron found is considerably lower than the figure reported by other investigators. This discrepancy is attributed primarily to a wandering of the electron beam. The neutron spectrum should be unaffected. In addition to the expected peak at 1 Mev the energy spectrum shows a secondary peak at about 5 Mev. The shape of the experimental spectrum, excluding this secondary peak, is fitted theoretically by a combination of the "evaporative" and "resonance direct" effects. (auth)

7999 (USNRDL-TR-490) GAMMA-RAY SPECTRUM OF Te^{131}. J. M. Ferguson and F. M. Tomnovec (Naval Radiological Defense Lab., San Francisco). Dec. 12, 1960. 16p.

The γ spectrum of 25-min Te^{131} was investigated with scintillation spectrometers. Gamma rays with energies of 0.145, 0.445, 0.604, 0.940, 0.985, and 1.13 Mev were found, and their relative abundances were measured. The 0.445- and 0.985-Mev γ's are in coincidence with the 0.145-Mev γ ray. A decay scheme is proposed with I^{131} levels at 0.145, 0.604, 0.940, and 1.13 Mev. (auth)

8000 (AEC-tr-4389) FORCING DEUTERONS FROM NUCLEI OF Li, Be, C, AND O BY 675 Mev PROTONS.

(Vybivaniye Deytronov Iz Yader Li, Be, C, i O Protonami s Energiyey v 675 Mev). L. S. Azhgirei (Azhgirey), I. K. Vzorov, V. P. Zrelov (Krelov), M. G. Mescheryakov, B. S. Neganov, and A. Shabudin. Translated from Zhur. Eksptl. i Teoret. Fiz. 33, 1185-95(1957). 21p.

This paper was previously abstracted from the original language and appears in NSA, Volume 12, as abstract No. 1744.

8001 (CEA-tr-R-1081) CONTRIBUTION À LA THEORIE DES RÉACTIONS PHOTONUCLÉAIRES. (Contribution to the Theory of Photonuclear Reactions). V. M. Agranovich and V. S. Stavinskii (Stavinsky). Translated into French by B. Vinogradoff from Zhur. Eksptl'. i Teoret. Fiz. 34, 700-6(1958). 20p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 12, as abstract No. 10136.

8002 (JPRS-6624) PROBLEMS OF NUCLEAR PHYSICS (II ALL-UNION CONFERENCE ON NUCLEAR REACTIONS AT SMALL AND MEDIUM ENERGIES). V. S. Ermakov (Yermakov) and T. L. Perel'man. Translated from Inzhener.-Fiz. Zhur., Akad. Nauk Belorus. S.S.R. 3, 139-43(1960). 7p.

A summary is presented of the conference on small and medium energy nuclear reactions held in Moscow on 21 to 28 July, 1960. It is pointed out that the study of nuclear reactions at low energies necessarily involved an examination of the entire complex of problems concerned with the structure of the nucleus. Problems concerned with the physics of fission and slow neutrons, nuclear spectroscopy, and high-energy physics were not discussed. The papers dwelt on a number of trends developed lately, such as research using multi-charged ions, direct nuclear interactions, the Mössbauer effect during resonance scattering of γ quanta, low-nucleonic systems, photonuclear reactions, and nuclear models. (JPRS)

8003 AN ALPHA-PARTICLE MODEL FOR SOME LIGHT NUCLEI. P. D. Kunz (Univ. of Washington, Seattle, Wash.). Ann Phys. (N. Y.) 11, 275-305(1960) Nov.

The α-particle model is generalized to include the effects of rotational-particle coupling that mixes bands and a procedure to take into account the effect of the exclusion principle between the nucleons in the α particles and those outside the α particles. The latter nucleons are taken to interact with the α particles by a potential which is derived from scattering data. In the case of Be^9 most of the levels below 11 Mev are described as belonging to either a band that has an angular momentum projection $^3/_2-$ on the α-α axis or a band that has a projection of $^1/_2-$. The model predicts the presence of low-lying positive parity levels as found experimentally. The ground-state magnetic dipole and electric quadrupole moments and the cross sections for inelastic scattering are calculated and compared with experiment. The model is applied to Be^{10}, and the (p,γ) angular correlation is computed for the reaction $Be^9(d,P)Be^{10*}(\gamma)Be^{10}$. (auth)

8004 AN ISOTOPE EFFECT IN THE COLLECTION ON CHARGED PLATES OF (n,γ) RECOIL PRODUCTS OF BROMINE. H. J. Arnikar and A. Lal (Banaras Hindu Univ., India). Indian J. Phys. 34, 441-8(1960) Oct.

A study of the relative yields of Br^{80}, Br^{80m}, and Br^{82} by an analysis of the time-decay curves, following irradiation of C_6H_5Br for 9 days show that the apparent yield of Br^{80} on the anode plate is roughly twice that of Br^{82}. The results are discussed in comparison with standard data for the thermal-neutron-capture cross sections of the corresponding target atoms Br^{79} and Br^{81} and their relative abundances. The findings, considered along with the probable counting efficiency for the resulting radioactive products and their decay characteristics, point to the existence of a small but definite net isotope effect in the over-all process of recoil, charge acquisition, and collection on the charged plate. (auth)

8005 THE THERMAL NEUTRON CAPTURE CROSS-SECTION AND THE RESONANCE CAPTURE INTEGRAL OF ^{100}Mo. M. J. Cabell (Atomic Energy Research Establishment, Harwell, Berks, England). J. Nuclear Energy, Pt. A. Reactor Sci. 12, 172-6(1960).

Using an activation method, the thermal-neutron-capture cross section of Mo^{100}, its resonance capture integral (from 0.5 ev to ∞), and its effective capture cross section in a lattice position of BEPO were found to be 0.199 ± 0.005 barns, 3.73 ± 0.20 barns, and 0.31 barns, respectively. (auth)

8006 RESONANT SCATTERING OF THE 14-keV. IRON-57 γ-RAY, AND ITS INTERFERENCE WITH RAYLEIGH SCATTERING. P. J. Black and P. B. Moon (Univ. of Birmingham, Eng.). Nature 188, 481-2(1960) Nov. 5.

Experiments were conducted in which the resonant scattering in metallic iron of the 14-kev line of Fe^{57} was found to have the expected intensity. Following these experiments it was decided that a foil of 65% Fe^{57} would give comparable amplitudes of resonant and Rayleigh scattering at convenient angles. An angle of 43 ± 2° was chosen which would include the (211) Bragg reflection. The source, ~20 mc Co^{57} in a matrix of Fe^{56}, was mounted on a 30 cps vibrator so that the exact energy of the emitted radiation could be oscillated through the resonant energy. Graphical representations are included of the intensity of transmission through, or scattering from, the foil as a function of positive velocity and of negative velocity at the center. The latter curve shows that the peaks appeared, as expected, more widely spaced than the dips with no evidence of general shift. If there is some coherence of phase between resonant and Rayleigh scattering, it should be found in quadrature at the same resonance moving toward coincidence of phase on the high-frequency side. The observed shift and broadening are probably to be explained in terms of such coherence, but the measurements are not yet detailed enough to show clearly the asymmetry of line-shape that is to be expected or to determine what percentage of coherence exists; full coherence is not expected when the incident line is of similar breadth to that of the resonance. Neither shift nor broadening of scattered resonance was observed in ordinary iron (2.2% Fe^{57}) at a mean angle of 90°, in the presence of a relatively large intensity of Rayleigh scattering. (B.O.G.)

8007 NEW DELAYED-NEUTRON PRECURSORS. G. Rudstam, A. Svanheden, and A. C. Pappas (Gustaf Werner Inst. for Nuclear Chemistry, Uppsala). Nature 188, 1178-80(1960) Dec. 31.

Delayed neutron precursors are expected to appear from the lightest to the heaviest nuclides on the neutron-rich side of the β-stability line. The distance from it in Z should be from about 3 to about 7 charge units, depending on the neutron number. A search was made experimentally for some of these precursors. Spallation reactions were studied. These give products in highest yields near the target nuclide, whereas yields of distant products depend mainly on the irradiation energy. By choosing suitable target elements and bombarding energies, it was possible to detect and localize eventual delayed neutron precursors.

The short half-lives and the low neutron yield (the latter caused by the rather small branching ratio to the neutron-emitting state of the delayed neutron emitter) necessitate that the measurements start immediately after irradiation. This requirement was fulfilled by placing the neutron detector at a small radial distance from the irradiated target in the vacuum chamber of the synchro-cyclotron. Results are summarized. (C.H.)

8008 EXCITATION FUNCTIONS OF (d,α)- AND (d,αn)- REACTIONS ON NATURAL TUNGSTEN. A. Demildt (Universiteit, Ghent). Nature 189, 51(1961) Jan. 7.

Natural tungsten was irradiated with 22-Mev deuterons. Three species of radioactive tantalum were observed due to the following reactions: W^{184}(d,α)Ta^{182}; W^{186}(d,α)Ta^{184}; and W^{186}(d,αn)Ta^{183}. The chemical separation of these nuclides was performed by selective liquid-liquid extraction with di-isobutylketone in hydrofluoric-hydrochloric acid medium in the presence of tantalum carrier. Absolute tantalum activities were determined by means of a calibrated end-window Geiger tube. Results are tabulated. (C.H.)

8009 THE QUADRUPOLE MOMENT OF EUROPIUM. K. Krebs and R. Winkler (Technische Univ., Berlin). Naturwissenschaften 47, 490-1(1960) Nov. (1). (In German)

An investigation was made to increase the accuracy of the Q values of europium, previously estimated as Q(Eu^{151}) ~ +1.2 b and Q(Eu^{153}) ~ +2.5 b. With a Perot-Fabry interferometer, the Eu II line 3819 λ was studied. Five hyperfine structure components of Eu^{151} and four of Eu^{153} were measured. The splitting factors were determined. An average value was obtained of $Q_{151} = 0.95 \pm 0.1$ b and $Q_{153} = 2.42 \pm 0.2$ b. From the Coulomb excitation of Eu^{153}, the values $Q_{151} = 0.93 \pm 0.1$ b and $Q = 2.36 \pm 0.25$ b were obtained, in good agreement with the optical values. The ratio of the A factors obtained in the present work is compared with the values obtained previously. (J.S.R.)

8010 THE SCATTERING OF ALPHA PARTICLES AND DEUTERONS BY IODINE-127. I. J. Van Heerden (National Physical Research Lab., C.S.I.R., Pretoria) and D. J. Prowse. Nuclear Phys. 19, 589-603(1960) Dec. (2). (In English)

The differential elastic scattering cross sections of 38 Mev α particles as well as 8- and 19.5-Mev deuterons by I^{127} were determined using nuclear emulsions. The angular distributions obtained were analyzed according to Porter's model of absorption along classical undistorted Coulomb orbits. Information is thus obtained about the mean free path of the incident particles in nuclear matter. Indications of the existence of a Cohen peak in the inelastic scattering were observed; the evidence is described, and the implications are discussed. (auth)

8011 REACTION MECHANISM STUDIES ON Si^{28}(d,p)Si^{29}. I. DISTORTED WAVE EFFECTS. J. A. Kuehner, E. Almqvist, and D. A. Bromley (Atomic Energy of Canada Ltd., Chalk River, Ont.). Nuclear Phys. 19, 614-33(1960) Dec. (2). (In English)

A study of the (p,γ) angular correlations involving the 1.28- and 2.03-Mev states in Si^{29} populated by the Si^{28}(d,p)Si^{29} reaction was carried out for deuteron energies in the range from 6 to 9 Mev. In each case measurements were carried out in the (d,p) reaction plane with protons detected on the observed peak of the $l_n = 2$ stripping angular correlation. These data were analyzed within the framework of distorted-wave stripping formalism. The measurements on the 2.03-Mev state alone enabled the statistical tensors for the reaction to be determined for each incident deuteron energy. These statistical tensors were then used to compute the angular correlation of the 1.28-Mev radiation, yielding results in good agreement with the experimental measurements and thus supporting the expectation that the matrix elements are essentially independent of the detailed nuclear structure of the final state. The statistical tensors were also used to predict the general (p,γ) angular correlation function over the sphere as well as the magnitude of the proton polarization for the Si^{29}*-proton systems involving both the 1.28-Mev and 2.03-Mev excited states. (auth)

8012 ON THE DECAY OF 5.8 d Sb^{120}, 5.1 h Sb^{118} AND 1 h Sb^{116}. B. Skytte Jensen, O. B. Nielsen, and O. Skilbreid (Inst. for Theoretical Physics, Copenhagen). Nuclear Phys. 19, 654-64(1960) Dec. (2). (In English)

Activities of Sb^{116}, Sb^{118}, and Sb^{120} were produced in the Sn(d,n)Sb or In(α,n)Sb reactions. Sources for β- and γ-ray spectroscopy were prepared in an isotope separator. The radiations were studied in two six-gap β-ray spectrometers and by scintillation spectrometers in connection with a 100-channel kicksorter. The decay scheme of McGinnis for Sb^{120} was confirmed, and schemes for 1 h Sb^{116} and 5.1 h Sb^{118} are proposed. The level schemes of the single closed-shell nuclei Sn^{116}, Sn^{118}, and Sn^{120} were compared with the calculation of Kisslinger and Sorensen. (auth)

8013 MEASUREMENT OF THE ROTATIONAL g-FACTOR (g_R) FOR SEVERAL NUCLEI. Geoffrey Manning and John Rogers (California Inst. of Tech., Pasadena). Nuclear Phys. 19, 675-87(1960) Dec. (2). (In English)

The g-factors of several excited states of nuclei were measured by observing the rotation of the angular correlation for a source in a magnetic field. The results are: 122-kev state of Sm^{152} ($\tau = 2.0 \times 10^{-9}$ sec) g = 0.28 ± 0.07; 123-kev state of Gd^{154} ($\tau = 1.7 \times 10^{-9}$ sec) g = 0.4 ± 0.5; 81-kev state of Er^{166} ($\tau = 2.4 \times 10^{-9}$ sec) g = 0.31 ± 0.06; 87-kev state of Dy^{160} ($\tau = 2.5 \times 10^{-9}$ sec) g = (0.28 ± 0.08); and 118-kev state of Tm^{169} ($\tau = (9.0 \pm 1.5) \times 10^{-11}$ sec) g = 0.20 ± 0.06. The assumptions used in deducing the g-factors from the observed rotations are discussed. A discussion of available evidence suggests that the rotational g-factor g_R is less than Z/A. The g-factor of the 118-kev state of Tm^{169} is discussed on the basis of the Nilsson model. (auth)

8014 THE HYPERFINE STRUCTURE OF ^{209}Bi. R. S. Title and K. F. Smith (Cavendish Lab., Cambridge, Eng.). Phil. Mag. (8) 5, 1281-9(1960) Dec.

The hyperfine structure (H.F.S.) of the J = 3/2 ground state of Bi^{209} was found by the atomic beam magnetic resonance method. Two of the three H.F.S. intervals were measured directly, giving $(W_{50} - W_{80})/h = 2884.7 \pm 0.2$ Mc/s and $(W_{40} - W_{50})/h = 2171.5 \pm 0.1$ Mc/s. The results are consistent with a magnetic dipole interaction constant A of -446.97 ± 0.04 Mc/s and an electric quadruple interaction constant B of -303.3 ± 0.3 Mc/s. The latter yields an uncorrected nuclear electric quadrupole moment of −0.34 barns, and the field dependence of $\Delta F = 0$ transitions gives -1.6433 ± 0.0002 for the ground state g_J value. (auth)

8015 THE HYPERFINE STRUCTURE OF ^{121}Sb AND ^{123}Sb. P. C. B. Fernando, G. K. Rochester, I. J. Spalding, and K. F. Smith (Cavendish Lab., Cambridge, Eng.). Phil. Mag. (8) 5, 1291-8(1960) Dec.

The hyperfine structure of the J = 3/2 ground state of Sb^{121} and Sb^{123} was studied by the atomic beam magnetic resonance method, and the results are consistent with the following values for the interaction constants: $g_J = -1.9705 \pm$

0.0002, $A_{121} = -(299.034 \pm 0.004)$ Mc/s, $A_{123} = -(162.451 \pm 0.003)$ Mc/s, $B_{121} = -(3.68 \pm 0.02)$ Mc/s, and $B_{123} = -(4.67 \pm 0.03)$ Mc/s. To the accuracy of the measurements there was no evidence for an octupole interaction. From the B values, $Q_{121} = -(0.20 \pm 0.03) \times 10^{-24}$ cm^2 and $Q_{123} = -(0.26 \pm 0.04) \times 10^{-24}$ cm^2 is obtained, and comparison of A_{121}/A_{123} with the ratio of g_{121}/g_{123} already published gives $-0.318 \pm 0.003\%$ for the hyperfine structure anomaly. Intermediate coupling theory accounts satisfactorily for g_j, but an admixture of excited s states is necessary to explain the observed magnetic interaction and anomaly. (auth)

8016 THE SPIN OF ^{124}Sb AND THE SPIN AND MOMENTS OF ^{122}Sb. P. C. B. Fernando, G. K. Rochester, and K. F. Smith (Cavendish Lab., Cambridge, Eng.). Phil. Mag. (8) 5, 1309(1960) Dec.

The spin of Sb^{124} and the spin and the hyperfine structure of Sb^{122} were measured. It was found that $I_{124} = 3$ and $I_{122} = 2$, both agreeing with previous results. The $\Delta F = 1$ transitions $5/2, -1/2 \rightleftharpoons 3/2, 1/2$ and $7/2, -3/2 \rightleftharpoons 5/2, -3/2$ were observed in Sb^{122}, from which it was deduced that $A_{122} = +212.01 \pm 0.06$ Mc/sec and $B_{122} = +8.7 \pm 0.5$ Mc/sec. The ratio A_{122}/A_{121} is consistent with the Pipkin ratio g_{122}/g_{121}, but no value was deduced for the hyperfine structure anomaly because the ±1% error in the g ratio is much greater than a typical s state anomaly. The uncorrected quadrupole moment derived from B_{122} is $Q_{122} = (+0.47 \pm 0.03) \times 10^{-24}$ cm^2. (B.O.G.)

8017 10-Mev PROTON REACTION CROSS SECTIONS FOR Cu^{63} AND Cu^{65}. Richard D. Albert and Luisa F. Hansen (Univ. of California, Livermore). Phys. Rev. Letters 6, 13-14(1961) Jan. 1.

The (p,n) reaction cross sections were measured for Cu^{63} and Cu^{65} at 9.85-Mev protons and found to be 510 and 700 mb, respectively; if these results are combined with the (p,q) cross sections, they yield a $\sigma_R (= \sigma(p,q) + \sigma(p,n))$ of 875 and 855 mb, respectively, which agrees with the optical model better than that of Meyer and Hintz. (D.L.C.)

8018 STUDY OF NUCLEAR STRUCTURE FROM COULOMB ENERGY DIFFERENCES OF MIRROR LEVELS. K. Wildermuth and Y. C. Tang (Florida State Univ., Tallahassee). Phys. Rev. Letters 6, 17-19(1961) Jan. 1.

A scheme is outlined in which the Coulomb energy differences between energy levels in mirror nuclei can be used to obtain valuable information about the cluster structures of the levels. The scheme is illustrated with examples using $F^{19}-Ne^{19}$ and $F^{17}-O^{17}$ mirror nuclei pairs. The theoretical energy differences were calculated from the cluster model for the following mirror nuclei pairs: Li^5-He^5, Be^7-Li^7, $C^{11}-B^{11}$, $N^{13}-C^{13}$, and $Ne^{19}-F^{19}$; the agreement between calculated and experimental values is fairly good. (D.L.C.)

8019 SOME (t,p) REACTIONS IN LIGHT NUCLEI. A. A. Jaffe, F. de S. Barros, P. D. Forsyth, J. Muto, I. J. Taylor, and S. Ramavataram (Univ. of Manchester, England). Proc. Phys. Soc. (London) 76, 914-28(1960) Dec.

The (t,p) reactions induced in the target nuclei B^{10}, C^{12}, O^{16}, and Al^{27} were investigated at an incident triton energy of 5.5 Mev. The angular distributions of the observed proton groups were compared with a theory of double stripping and good agreement was obtained with the theoretical predictions for transfers of 0, 1, 2, and (more tentatively) 3 units of orbital angular momentum. A level in B^{12} at 4.297 Mev is reported. Spin and parity assignments have been made for the levels of C^{14} at 6.582 Mev (1^-), 6.725 Mev (probably 3^-), a hitherto unreported level at 7.009 Mev (0^+) and at 7.335 Mev (probably 2^-). Levels in O^{18} at 3.634 and 4.448 Mev were confirmed and the spins and parities were determined to be 0^+ and 3^-, respectively. The spin and parity of the state in O^{18} at 3.915 Mev excitation were determined as 2^+. The behavior of the $O^{16}(t,p)O^{18}$ reaction leading to the ground and first four excited states of O^{18} was found to be consistent with the O^{18} configurations predicted by the intermediate coupling theory. The atomic mass excess of Al^{29} was found to be -9.647 ± 0.015 Mev and the excitations of 42 new levels of Al^{29} were measured. (auth)

8020 FORM FACTORS OF THE NUCLEUS ^{6}Li. Daphne F. Jackson (Battersea Coll. of Technology, London, England). Proc. Phys. Soc. (London) 76, 949-58(1960) Dec.

Experimental results for the elastic scattering of high energy electrons from Li^6 were fitted using a charge distribution derived from a smoothed finite potential $V(r) = -V_0 + \frac{1}{2}Kr^2$, $r < r_0$ and $V(r) = -Ae^{-\mu r}$, $r > r_0$, which has identical parameters for s- and p-nucleons. An rms radius of 2.72 ± 0.08 Fermi and a central nuclear density of 0.14 ± 0.01 particles per cubic Fermi are obtained. The form factors for inelastic scattering are calculated for three models which fit the elastic scattering and it appears that the inelastic scattering is much more sensitive to choice of parameters. The total energy of the Li^6 nucleus is calculated on the independent particle model, including a correction for the spurious energy of the center of mass. (auth)

8021 THE ELASTIC SCATTERING OF ^{3}He BY ^{3}He. B. H. Bransden and R. A. H. Hamilton (Univ. of Glasgow, Scotland). Proc. Phys. Soc. (London) 76, 987-9(1960) Dec.

The elastic scattering cross section of He^3 by He^3 is calculated using the equations for an equivalent central potential between nucleons and the wave function. Values were obtained for incident energies of 20, 26, and 29 Mev, for potentials having exchange properties of the Serber, symmetrical, and Biel types. The results indicate that although the cross section at large angles is in reasonable agreement with experiment, the deep minimum observed in the experimental cross section at 35 to 40° is not reproduced. It may be concluded that the model fails for the $He^3 + He^3$ system, while good agreement is found for He^4 elastic scattering by He^4 using the same model. (B.O.G.)

8022 THE LIFETIME OF THE He^- ION. D. R. Sweetman (Atomic Weapons Research Establishment, Aldermaston, Berks, England). Proc. Phys. Soc. (London) 76, 998-1000(1960) Dec.

Measurements were made which set a lower limit on the He^- lifetime and which indicate the size of the loss cross sections for interactions with gas molecules. A beam of He^+ ions was accelerated to 1 Mev, magnetically analyzed, and passed down a tube in which it was partly converted to the He^- state. The He^- ions were separated from the other charge states by a 4° bending magnet. The He^- beam and the He^0 particles produced in the He^- beam decay in a 60-cm drift tube were counted simultaneously. The ratio, $R = He^0/(He^0 + He^-)$, is related to the lifetime τ by the expression $R = 1 - \exp(-L/v\tau)$, where L is the drift tube length and v is the particle velocity. An average ratio value of $R = 7.75 \times 10^{-3}$ was found for several runs at a He^- count rate of ~ 1000 per second. Assuming all the He^0 beam was produced by natural decay of He^-, the minimum lifetime is 1.0×10^{-5} sec. The cross section for the reaction $He^- \rightarrow He^0$ on interaction with helium gas was found to be $2.13 \pm 0.20 \times 10^{-16}$ cm^2 per molecule at 1.09 Mev. (B.O.G.)

8023 FLUORESCENCE OF THE 15.1 MEV LEVEL OF ^{12}C. S. S. Hanna and R. E. Segel (Oxford Univ.). Proc. Roy. Soc. (London) A259, 267-74(1960) Dec. 6.

Resonance scattering from the 15.1-Mev level in C^{12} was measured. The broad photon spectrum from the $Li^7(p,\gamma)Be^8$ reaction was used as a source of 15.1-Mev radiation and the resonantly scattered γ rays detected with a large NaI(Tl) crystal. The quantity $\Gamma_{\gamma_0}\sqrt{\Gamma_{\gamma_0}/\Gamma}$ was measured and found equal to (47.0 ± 6.0) ev. Combining this result with the branching ratios for the various modes of decay of the 15.1-Mev C^{12} state, the value Γ_{γ_0} = (50.5 ± 7.1) ev for the ground-state transition was deduced. (auth)

8024 ALPHA-PARTICLE DECAY OF THE 15.1 MEV STATE IN ^{12}C. G. L. Miller (Brookhaven National Lab., Upton, N. Y.), R. E. Pixley, and R. E. Segel. Proc. Roy. Soc. (London) A259, 275-84(1960) Dec. 6. (BNL-4873).

A search was carried out for the α decay of the 15.1-Mev state in C^{12}. The state was made by the $B^{10}(He^3,p)C^{12}$ reaction. The protons feeding the 15.1-Mev state were seen in proton singles spectra and in coincidence with 15.1-Mev γ rays, but none were seen in coincidence with α particles. Comparison with a nearby state known to decay virtually solely by α particles established that the 15.1-Mev state decays by α emission less than 20% of the time. Combining this result with the results of γ resonance scattering it was found that $\Gamma_\alpha < 15$ ev. The sensitivity of the experiment was limited by a continuum from the break-up of the B^{10} + He^3 system. (auth)

8025 THE NUCLEAR ALIGNMENT OF PROMETHIUM ISOTOPES AND THE DECAY SCHEME OF ^{149}Pm. C. J. S. Chapman, M. A. Grace, J. M. Gregory, and C. V. Sowter (Clarendon Lab., Oxford). Proc. Roy. Soc. (London) A259, 377-85(1960) Dec. 29.

Nuclear alignment of the isotopes Pm^{149} and Pm^{151} was obtained in the ethyl sulfate and double nitrate lattices by the low-temperature alignment method. The anisotropic γ-ray angular distributions were used to detect this alignment. The results suggest that in the double-nitrate lattice the lowest ionic state of Pm^{3+} is a singlet and that alignment arises through a 'pseudo-quadrupole' mechanism. Beta and γ-spectroscopy measurements show that the 285-kev γ ray in the decay of Pm^{149} is associated with a weak (1.8 ± 0.3%) β-group of maximum energy 0.77 ± 0.05 Mev. The alignment measurements are consistent with this 285-kev γ ray being principally M1 with the spin of the excited state being $^5/_2$ or $^3/_2$. (auth)

8026 UNDISCOVERED ISOTOPES OF THE LIGHT ELEMENTS. A. I. Baz, V. I. Gol'danskiĭ, and Ya. B. Zel'dovich. Uspekhi Fiz. Nauk 72, 211-34(1960) Oct. (In Russian)

The principal properties of a neutron-deficient isotope (Z > N) can be deduced from the known data of its isotope conjugate (a pair of nuclei are conjugate if $Z_1 = N_2$ and $N_1 = Z_2$). For example, the binding energy of $_{11}Na^{25}_{14}$ is known to be 8.84 Mev. The binding energy of a proton in the undiscovered conjugate, $_{14}Si^{25}_{11}$, is 3.64 Mev (stable to proton emission). The energy of β^+ decay $Si^{25} \rightarrow Al^{25}$ (ground state) is found to be 11.6 Mev from the known masses of Al^{24} and Al^{25}. The prediction for the half-life of Si^{25} is ~0.5 sec. The mass defect, energy, half life, and occurrence of proton or double-proton emission are listed for the isotopes of light elements (Z < 36). The possibility of detecting decay by the simultaneous emission of two protons near the limit of stability of isotopes with even Z is discussed. Extrapolations from a plot of the difference in energy levels with various isotopic spins can be used to predict stable nuclei of isotopes with excess neutrons (N > Z). An isotope with an even number of neutrons is always more stable than a neighboring isotope with an odd number of neutrons. The possibility of the existence of the dineutron (n^2) and its detection is discussed. (TTT)

8027 STRIPPING REACTIONS WITH POLARIZED DEUTERONS. Rudolf Botzian (Rheinisch-Westfalische Technische Hochschule, Aachen). Z. Physik 160, 573-86 (1960). (In German)

The nucleons liberated in a (d,p) or (d,n) stripping-reaction are generally polarized even if unpolarized deuterons are used. These reactions are examined for polarized deuterons in order to provide more detailed information concerning the interactions between the reaction products. (auth)

8028 BETA SPECTRUM AND HALF-LIFE OF Rb^{87}. K. Egelkraut and H. Leutz (Universität, Heidelberg, Ger.). Z. Physik 161, 13-19(1961). (In German)

The β-decay of Rb^{87} was studied with a scintillation spectrometer. To avoid source absorption and scattering RbI(Tl)-, NaI(Tl) + RbI- and CsI(Tl) + RbI-crystals were used. The β-spectrum was measured down to 6 kev and the observed maximum β-energy was found to be 275 ± 5 kev. The specific activity of natural rubidium was determined at 740 ± 10 cps per gram and the half life of Rb^{87} at (5.82 ± 0.1) × 10^{10} years. (auth)

8029 THE QUADRUPOLE MOMENT OF COPPER ISOTOPES AND THE HYPERFINE STRUCTURE OF THE $3d^94s^2m^2D - 3d^{10}4p^2P$ TRANSITIONS IN COPPER I-SPECTRUM. Wolfgang Fischer (Universität, Marburg, Ger.). Z. Physik 161, 89-98(1961). (In German)

Using electromagnetically separated isotopes, the hyperfine structure of the transitions $3d^94s^2m^2D - 3d^{10}4p^2P$ was studied by interference spectroscopy. From the A and B factors of the terms $3d^94s^2m^2D_{3/2,5/2}$ the following values for the quadrupole moments of copper isotopes were calculated: $Q(Cu^{63})$ = (−0.20 ± 0.04) × 10^{-24} cm^2, and $Q(Cu^{65})$ = (−0.19 ± 0.04) × 10^{-24} cm^2. Also, the isotope shifts for these transitions were measured. (tr-auth)

8030 THE INTERACTION OF POLARIZED NUCLEONS WITH NUCLEI. E. J. Squires (Atomic Energy Research Establishment, Harwell, Berks, Eng.). p.47-96 of "Progress in Nuclear Physics. Vol. 8." New York, Pergamon Press, 1960.

The work on scattering of nucleons with polarized spin is reviewed and compared with optical model theory, especially for elastic scattering. Charge exchange and stripping reactions in which the polarization of the outgoing nucleons was measured are also reviewed. It is concluded that interactions of polarized nucleons with nuclei can be understood in terms of the direct interaction mechanism except at very low energies. 113 references. (D.L.C.

8031 COLLECTIVE MOTION IN NUCLEI. D. M. Brink (Clarendon Lab., Oxford, England). p.97-141 of "Progress in Nuclear Physics."

The present state of research and knowledge of collective motion in nuclei is reviewed for both even-even and odd nuclei, and advances in this field which have not been covered previously by a review article are treated in detail. The rotational and vibrational models are introduced for even-even nuclei and then applied to odd nuclei with the aid of weak coupling. The unified model or the deformed shell model using the adiabatic approximation and the problem of moment-of-inertia calculation are discussed. Some particle coupling schemes for correlating the shell and collective models are outlined; the seniority coupling scheme is shown to result in a vibrational type energy spectrum. The transition from weak to strong coupling and the effects of nucleus deformation on its energy are

considered. It is concluded that the rotational model is well established and that the vibrational model is now better understood. 79 references. (D.L.C.)

8032 PROCEEDINGS OF THE INTERNATIONAL CONFERENCE ON NUCLEAR STRUCTURE, KINGSTON, CANADA, AUGUST 29–SEPTEMBER 3, 1960. D. A. Bromley and E. W. Vogt, eds. Toronto, Univ. of Toronto Press and Amsterdam, North Holland Publishing Co., 1960. 995p.

One hundred and fifty-nine papers are included. The papers consist of review articles and research contributions. In addition, 248 abstracts of research contributions are included. One hundred and fifty-six of the papers are covered by separate abstracts. (M.C.G.)

8033 OPEN PROBLEMS. I. R. E. Peierls. p.7-19 of "Proceedings of the International Conference on Nuclear Structure."

The purpose of nuclear research, its applications, and some of the problems now under study are reviewed. The nature of nuclear forces and the many-body problem and its connection with the Shell Model are discussed. (M.C.G.)

8034 OPEN PROBLEMS. II. D. H. Wilkinson. p.20-66 of "Proceedings of the International Conference on Nuclear Structure."

Structure problems in light nuclei include the difference between the experimental level schemes for the 1 p-shell and the predictions of the Shell Model. A related problem is that of the position of states of multiple excitation. The nuclear surface thickness parameter was determined by the elastic scattering of He^3 by tin. The momentum distribution in the nuclear surface was found by distorted wave analysis. In a study of the texture of the nuclear surface, results indicated that the nucleons of the nucleus tend to form clusters. A theoretical treatment of multi-nucleon nuclear parentage was developed, and some experimental techniques were derived to test it. Stripping and pickup reactions were investigated. Distorted wave computations of one-nucleon stripping were studied. Nuclear structure experiments at medium energies including knock-out reactions, γ production, and inelastic scattering are reviewed. The appearance of elementary particles other than the neutron and proton in the nucleus is discussed. (M.C.G.)

8035 THE PROPERTIES OF NUCLEAR FORCES WHICH ARE RELEVANT TO NUCLEAR STRUCTURE. K. A. Brueckner. p.67-75 of "Proceedings of the International Conference on Nuclear Structure."

Experimental studies of nucleon-nucleon scattering together with detailed phase-shift analyses were made. The features of these interactions, which determine the properties of nuclear matter and finite nuclei, are discussed. The most evident feature of the nuclear interaction is the great strength and short range of the attractions and the presence of a region of repulsion that appeared to be essentially impenetrable. In the consideration of nuclear structure, the most fundamental feature of the interaction is the presence of a repulsive core and a region of very strong attraction. Other features essential in determining the properties of nuclear matter include: an exchange character that weakens the interaction and gives most of the velocity dependence of the single particle potential; a long range tensor force that weakens the effective interaction; and the great strength and short range of potential, which lead to marked many-body effects and to strong state dependence of interactions. (M.C.G.)

8036 THE STRUCTURE OF NUCLEAR MATTER. C. Bloch. p.76-89 of "Proceedings of the International Conference on Nuclear Structure."

The work of Brueckner in revealing that nuclear matter could be treated as a low density system is reviewed. The method amounted almost to treating the system as a gas. Some problems and unsatisfactory results and the reasons for them are discussed. The convergence of the theory, the poles of the t-matrix, and the density of nuclear matter in the ground state as an oscillation function of position were studied. (M.C.G.)

8037 MODELS OF FINITE NUCLEI. A. de-Shalit. p.90-109 of "Proceedings of the International Conference on Nuclear Structure."

Good evidence exists that as a many-body problem, finite nuclei can be approximated by a state of independent particles with a weak residual interaction. The effects of this residual interaction can be simulated by such simple interactions as the pairing force, P_2-interactions, δ-force, and relative S-state interactions. Consistency tests of nuclear models are described. (M.C.G.)

8038 ON THE COLLECTIVE EXCITATIONS IN SUPERFLUID NUCLEAR MATTER. B. B. Dotsenko (U.S.S.R.) p.118-23 of "Proceedings of the International Conference on Nuclear Structure."

The energetic characteristics of the ground state and excited states of superfluid nuclear matter were determined using the method of N. N. Bogoliubov. Results indicated that collective excitation of two types exist: the "normal" excitations of fairly large energy (~30 Mev) and excitations of the "superfluid phase" with energy not greater than 1 Mev, which appears in the case of weak perturbations. (M.C.G.)

8039 NUCLEAR DEFORMATION AND NUCLEAR FORCE. K. Ikeda, S. Nagata, and K. Takada (Kyoto Univ., Japan). p.124-6 of "Proceedings of the International Conference on Nuclear Structure."

Nuclear deformation of the rotational nuclei, Mg^{24}, was determined by the variational method. The Hamiltonian was essentially that of Brueckner's shell model space, and the trial wave function was Nilsson's. The main contribution to the deformation came from central forces, and the role of spin-orbit and tensor forces for the deformation is shown qualitatively. (auth)

8040 REARRANGEMENT AND THE BARRIER AT THE EDGE OF A NUCLEUS. D. R. Inglis (Argonne National Lab., Ill). p.126-8 of "Proceedings of the International Conference on Nuclear Structure."

The energy gained by rearrangement of the other nucleons when one nucleon is adiabatically separated means that the barrier height confining shell-model wave functions is higher by that amount than the separation energy E_S, used conventionally. This is related to the surprising success of oscillator functions. Levels with small E_S have a small energy gain and may still be depressed. (auth)

8041 VELOCITY-DEPENDENT SINGLET POTENTIALS. M. Razavy, O. Rojo, and J. S. Levinger (Louisiana State Univ., Baton Rouge). p.128-30 of "Proceedings of the International Conference on Nuclear Structure."

Observed phase shifts were fitted for proton-proton scattering in the ^1S state with a well-behaved, velocity-dependent potential of the form $-V_0J_1(r) - (\lambda/M)\,\vec{p} \times J_2(r)\,\vec{p}$, where $\vec{p}$ is the quantum-mechanical operator. Two examples are given: $J_1 = J_2$ = a square well and J_1 of Yukawa shape combined with J_2 of exponential shape. (auth)

8042 NUCLEAR MODEL SUGGESTED BY THE MANY-BODY PROBLEM IN ONE DIMENSION. T. Sasakawa (Kyoto Univ., Japan). p.130-32 of "Proceedings of the International Conference on Nuclear Structure."

To gain insight into the structure of nuclear matter, the many-body system in one dimension was solved exactly. The wave function obtained represents the nature of liquid rather than gas, showing the saturation of density and binding energy. It shows strong opposition to the Fermi gas model as the zeroth approximation for nuclear matter. (auth)

8043 SOME CONSIDERATIONS ON THE STRUCTURE OF NUCLEAR MATTER. L. E. H. Trainor (Univ. of Alberta, Edmonton, Canada). p.133-4 of "Proceedings of the International Conference on Nuclear Structure."

Traditionally nuclear matter was treated as a many-nucleon problem. A new approach is to inquire into the state of the π meson field in the many-nucleon system. For this purpose, a meson-atomic model of the nucleon was devised, and the method of Wigner and Seitz was adapted from solid-state theory to investigate the problem. (auth)

8044 ELASTIC AND INELASTIC SCATTERING OF NEUTRONS. M. Walt. p.146-56 of "Proceedings of the International Conference on Nuclear Structure."

Some representative data on fast neutron scattering and the experimental features that can be reproduced by means of the optical model are presented. The optical-model fits to neutron elastic scattering are given for Sn, Cu, Fe, Al, and Bi. Nonelastic cross sections are given as a function of energy for Al, Fe, Cu, Zn, Ag, Sn, W, Au, and Bi. A comparison was made of experimental angular distributions below 17 Mev and optical-model calculations. The yield of γ rays produced by inelastic neutron scattering in Fe^{56} and Pb^{206} was investigated. The results indicated that the optical model gives a good representation of elastic and inelastic scattering although the fits to the elastic scattering data are not very good at low energies. (M.C.G.)

8045 REACTIONS AND SCATTERING OF CHARGED PARTICLES. P. C. Gugelot. p.157-68 of "Proceedings of the International Conference on Nuclear Structure."

Some effects in nuclear reactions which show deviations from the predictions of current models are reviewed. Elastic scattering of protons, α particles, and deuterons are discussed in connection with their electromagnetic break-up in the Clb-field of a heavy nucleus. Problems in the analysis of inelastic scattering and the gross structure in scattering and reactions are also mentioned. To determine whether or not the inelastic scattering excited states are different from those excited by stripping and pick-up reactions, the particle spectra were plotted as a function of excitation energy for Fe^{56}, Ni^{58}, and Ni^{60}. (M.C.G.)

8046 ELASTIC SCATTERING OF PROTONS FROM MEDIUM WEIGHT NUCLEI. A. P. Kliutcharev, et al. (Academy of Sciences, U.S.S.R., Kharkov). p.169-84 of "Proceedings of the International Conference on Nuclear Structure."

Angular distributions of elastically scattered protons were measured for Ni^{64}, Zn^{64}, and Zn^{68} at an energy of 5.4 Mev. The isotopes gave angular distributions resembling those of nuclei of odd mass numbers in an energy region nearer the potential barrier. Comparisons are given for experimental results on the scattering of protons from isotopes of chromium, nickel, and zinc. Angular distributions were also obtained for 6.8-Mev protons elastically scattered from Cr^{52}, Cr^{53}, Ni^{58}, Ni^{60}, Ni^{62}, Cu^{63}, and Cu^{65}, and from targets of Al, Fe, Co, Ni, Cu, Zn, Ag, Cd, Sn, Pb, and Bi of natural isotopic consistency. An analysis of the results showed a noticeable shift in the positions of maxima and minima in the distributions. It was also found that the distribution depends to a large extent on individual nuclear properties. (M.C.G.)

8047 POLARIZATION IN THE ELASTIC AND INELASTIC SCATTERING OF NUCLEONS. L. Rosen. p.185-96 of "Proceedings of the International Conference on Nuclear Structure."

Polarization resulting from elastic and inelastic scattering of neutrons and protons by complex nuclei is discussed. Studies of polarization from elastic scattering were made at energies of 0.380, 0.980, and 2.1 Mev. Excluding the measurements at a scattering angle of 125°, it was found that at all energies the polarization was predominantly positive for mass numbers above 150 and that it went through a negative maximum in the region of mass number 100. An unexpected feature of the 2.1-Mev data was the sharp oscillation in the sign of polarization near mass 100 at a scattering angle of 125°. Measurements of the polarization produced in the elastic scattering of protons were carried out between 6 and 12 Mev. It was observed that, aside from the very lightest nuclides, all the angular distributions of the polarization exhibited a systematic and uniform dependence on mass and angle. The magnitude of the polarization decreased with increasing atomic number of the target nucleus. (M.C.G.)

8048 THE PARAMETERS OF OPTICAL MODEL POTENTIAL AND THEIR PHYSICAL INTERPRETATION. D. S. Saxon. p.197-211 of "Proceedings of the International Conference on Nuclear Structure."

The optical-model parameters, determined phenomenologically from the analysis of experimental data, are summarized. The possible physical significance of these parameters is discussed. The uniform volume absorption potential contains six parameters and the surface absorption potential seven. Proton reaction cross sections were measured for Al, Ar, Ni, Cu, and Zn. They were also calculated using the volume absorption potential. The scattering of deuterons, He^3, α particles, and mesons(K) was also studied by this method. With one exception, very little progress was made in connecting the effective potential and the optical-model potential. This exception, high energy scattering at small angles, is discussed. (M.C.G.)

8049 OPTICAL MODEL ANALYSES OF HEAVY ION SCATTERING. R. H. Bassel and R. M. Drisko (Oak Ridge National Lab., Tenn.). p.212-14 of "Proceedings of the International Conference on Nuclear Structure."

The optical model, which was successful in analyses of neutron and proton elastic scattering from nuclei, was applied to the scattering of medium-energy nitrogen ions from carbon and beryllium. Using the usual Saxon potential shape to represent the real well and either the Saxon shape or a Gaussian shape for the imaginary well, good fits to the experiments are found over a limited angular region. (auth)

8050 $He^3 + He^3$ ELASTIC SCATTERING. J. L. Gammel, J. E. Brolley, Jr., L. Rosen, and L. Stewart (Los Alamos Scientific Lab., N. Mex.). p.215-17 of "Proceedings of the International Conference on Nuclear Structure."

The 20 and 25 Mev differential elastic scattering cross sections for $He^3 + He^3$ were measured with nuclear emulsions. The distributions were similar showing three distinct minima, but the differential cross-sections ratio $\sigma(25\ \text{Mev})/\sigma(20\ \text{Mev})$, was ~4 at 20° c.m. Phase-shift analyses were made using central forces; a unique set could not be determined from existing experimental measurements. (auth)

8051 PROTON TOTAL REACTION CROSS-SECTION FOR COPPER AT 9.3 MEV. G. W. Greenlees and O. N. Jarvis (Univ. of Birmingham, England). p.217-20 of "Proceedings of the International Conference on Nuclear Structure."

A measurement of 930 ± 70 mb was obtained for the proton total reaction cross section for copper at 9.3 ± 0.3 Mev by a poor-geometry transmission method not involving counter coincidence techniques. This result is appreciably higher than values predicted by published optical-model analyses using a volume absorption term and indicates the need of either a surface absorption or a larger radius for the volume absorption. (auth)

8052 ELASTIC SCATTERING OF MEDIUM ENERGY DEUTERONS BY GOLD AND SILVER. P. C. Gugelot, H. R. E. Tjin A. Djje, W. D. Whitehead, and F. J. de Heer (Instituut voor Kernphysisch Onderzoek, Amsterdam). p.220-2 of "Proceedings of the International Conference on Nuclear Structure."

Elastic scattering of deuterons by gold and silver was studied at a scattering angle range of 10 to about 40° in the forward direction for 14.5, 17.2, 21.7, and 24.3 Mev. In the angular distribution for gold, the deviation from the Rutherford behavior starts at a well-defined angle. This angle can be derived with the help of a semiclassical picture, assuming the possibility of disintegration of the deuteron in the Coulomb field. (auth)

8053 ELASTIC AND INELASTIC SCATTERING OF PROTONS BY OXYGEN AND NEON. S. Kobayashi (Univ. of Tokyo, Japan). p.223-5 of "Proceedings of the International Conference on Nuclear Structure."

Extensive experimental results are presented which show the variation with energy of the absolute angular distribution for the elastic and inelastic scattering of medium-energy protons (from 6.9 to 15.6 Mev) on oxygen and neon. (auth)

8054 SCATTERING PROTONS FROM LIGHT-MEDIUM-WEIGHT EVEN-EVEN NUCLEI. Kazuhisa Matsuda (Univ. of Tokyo, Japan). p.225-31 of "Proceedings of the International Conference on Nuclear Structure."

Results were obtained on the elastic and inelastic scattering to the first 2^+ state of protons from light-medium-weight nuclei. The elastic scattering showed the typical diffraction pattern in this mass and energy region. Angular distributions were determined in the elastic and inelastic scattering of protons from C, O, Ne, and Mg at 7 to 16 Mev. (auth)

8055 ELASTIC AND INELASTIC SCATTERING OF PROTONS FROM CARBON NUCLEUS FROM 6.5 MEV TO 16 MEV. Yukio Nagahara (Yokohama National Univ., Japan). p.234-7 of "Proceedings of the International Conference on Nuclear Structure."

The INS (Tokyo University) variable energy cyclotron was used to study proton scattering from carbon. Reaction yields were found to vary gradually with energy, but several distinct anomalies were observed, for example, at T_p = 9.1, 10.5, and 13.2 Mev. In the gradually varying regions, the angular distributions have some stable patterns which might be explained with the optical potential (Q = 0 reaction) and the direct interaction theory (Q = −4.43 reaction). Rather strong correlations were observed between Q = 0 and Q = −4.43 reactions, which could be attributed to the very small reaction yields via the other channels. Anomalies corresponded to the level structure of the compound nucleus N^{13}. (auth)

8056 A UNIFIED THEORY OF NUCLEAR REACTIONS. Yu. V. Tsekhmistrenko. p.240-3 of "Proceedings of the International Conference on Nuclear Structure."

A formalism for nuclear reactions, in which all known mechanisms could be obtained as special cases, is presented. Basic formulas and the derivations for special cases are given. It was found that the partial width for coherent scattering is equal to zero and that the energy structure of the amplitude does not determine the reaction mechanism. (M.C.G.)

8057 THE $Fe^{56}(n,n'\gamma)$ REACTION AND COMPARISON TO THEORY. D. M. Van Patter and R. W. Jackiw (Bartol Research Foundation, Swarthmore, Penna.). p.244-6 of "Proceedings of the International Conference on Nuclear Structure."

$Fe^{56}(n,n'\gamma)$ spectra were measured for E_n = 1.0 to 3.3 Mev at $\theta = 100°$ from an iron ring scatterer. Inelastic neutron cross sections were obtained after correction for the angular distribution of the 0.845 Mev γ ray, and were compared to theoretical predictions using various diffuse surface potentials. Comparisons with theory were also made for the excitation of individual levels up to 3.12 Mev in Fe^{56}. (auth)

8058 THE STUDY OF NUCLEAR STRUCTURE WITH HEAVY IONS. A. Zucker. p.247-54 of "Proceedings of the International Conference on Nuclear Structure."

Heavy ion research contributed to the study of nuclear structure in several ways. New nuclear configurations such as the $C^{12} + C^{12}$ "quasi molecule" were discovered. Scattering experiments were used to determine nuclear interaction distances by sharp cutoff analysis or a rainbow model calculation. Estimates were made of the reduced width of the outer neutrons in the nucleus from the results of transfer reaction studies. It was also found that very large amounts of angular momentum could be imparted to nuclear systems by heavy ion bombardment. (M.C.G.)

8059 QUASI-MOLECULAR STATES IN HEAVY ION REACTIONS. E. Almqvist. p.255-71 of "Proceedings of the International Conference on Nuclear Structure."

The elastic scattering of C^{12} ions on carbon, oxygen, and silicon and of O^{16} ions on oxygen, magnesium, aluminum, and silicon were studied in the energy range below 36 Mev. These data led to the postulation of a quasi-molecular interaction mechanism for the $C^{12} + C^{12}$ reaction. The resonant states were assumed to be those characteristic of a potential minimum of relatively large equilibrium radius. Interaction radii obtained using the Blair quarter point formalism are given. Excitation curves were measured for all γ radiation associated with C^{12} bombardment of C^{12}, N^{14}, O^{16}, F^{19}, and Ne^{20}, with O^{16} bombardment of O^{16} and Ne^{20}, and with N^{14} bombardment of N^{14}. In addition, excitation curves for α particles, protons, and neutrons were measured for the $C^{12} + C^{12}$ system and for α particles for the $O^{16} + O^{16}$ system. From the measured characteristics of the resonance observed in the $C^{12} + C^{12}$ reaction excitation curves it is possible to calculate directly the magnitude of the expected corresponding fluctuations in the elastic scattering excitation curves. (M.C.G.)

8060 MECHANISM FOR REACTIONS INVOLVING MASS TWO AND THREE NUCLEI. D. A. Bromley. p.272-309 of "Proceedings of the International Conference on Nuclear Structure."

A review of reaction studies involving nuclei of mass 2 and 3 is presented. For (d,p) reactions in the energy range 3.8 to 11 Mev it was found that for target nuclei with atomic numbers 25 to 60 the ratio of direct to compound reaction intensities remained constant at about 6. Searches were made for resonance effects in the reactions. Methods for extraction of reduced widths from experimental data are discussed. A distorted wave formalism developed for stripping reactions is outlined. Using central optical model potentials derived from available elastic scattering data, matrix elements and statistical tensors in the Born approxi-

mation were calculated. In cases of high compound binding energy, even at low incident energies in He^3 or triton reactions, definite evidence for significant direct interaction mechanisms was obtained. Angular distributions from He^3 and triton reactions were found to be almost independent of incident energy. The Newns theory for double nucleon stripping was remarkably successful in fitting experimental data from these reactions. (M.C.G.)

8061 NUCLEON INDUCED DIRECT INTERACTIONS. R. M. Eisberg. p.310-22 of "Proceedings of the International Conference on Nuclear Structure."

The mechanisms of nucleon induced direct nuclear reactions are discussed with distinctions made between a collective interaction and the sum of a number of two-body interactions. Several examples of experiments along this line are included. Results show that in every case of nucleon induced reactions, the mechanisms for direct interaction involve basically two-body interactions. Evidence indicates that this is due to the short range of nuclear forces. (M.C.G.)

8062 DIRECT REACTION THEORIES. N. Austern. p.323-35 of "Proceedings of the International Conference on Nuclear Structure."

Direct reactions in the absence of any competing compound nucleus contribution are reviewed. The distorted wave Born approximation and the way in which it meets most current requirements for accuracy are outlined. From this theory, equations connecting the various possible angular correlation and polarization experiments at a given scattering angle were derived. Some theories of surface reactions and calculations based on them are discussed. (M.C.G.)

8063 COMPETITION BETWEEN DIRECT INTERACTIONS AND COMPOUND NUCLEAR PROCESSES. S. Yoshida. p.336-40 of "Proceedings of the International Conference on Nuclear Structure."

The effect of interference between the direct and compound nuclear processes is discussed. The cross sections for the reactions consist of three parts: the direct interaction contribution, the compound nucleus contribution, and the interference term between the two contributions. Some analyses of reactions for this interference effect are described. (M.C.G.)

8064 THRESHOLD STATES OF NUCLEI. A. I. Baz (Inst. of Atomic Energy, Moscow, USSR). p.341-3 of "Proceedings of the International Conference on Nuclear Structure."

A study was made of the assumption that the interaction between the nucleon and the nucleus may be described in terms of a static potential. It was found that the level density of a nucleus near different 2-particle thresholds must be higher than in regions far from the thresholds and considerations of charge invariance cannot be applicable if the energy of the system lies near a two-particle threshold. A formalism in which allowance is made for unstable final products in nuclear reactions is discussed. (M.C.G.)

8065 SOME (t,d) REACTIONS IN LIGHT NUCLEI AT 5.5 MEV. F. de S. Barros, P. D. Forsyth, A. A. Jaffe, and I. J. Taylor (Univ. of Manchester, England). p.344-7 of "Proceedings of the International Conference on Nuclear Structure."

Angular distributions and absolute cross sections were measured for several deuteron groups emitted from targets of natural boron, carbon, silicon dioxide, and aluminum bombarded with 5.5 Mev tritons. The results were compared with the available data on the (d,p) reactions between the same initial and final nuclear states. (auth)

8066 NEUTRONS FROM (p,n) REACTIONS IN SEVERAL INTERMEDIATE WEIGHT NUCLEI. T. W. Bonner and Richard L. Bramblett (Rice Univ., Houston, Tex.). p.347-9 of "Proceedings of the International Conference on Nuclear Structure."

Energy spectra and angular distributions of neutrons were measured for (p,n) reactions in several intermediate weight nuclei at a proton bombarding energy of 5 Mev. The data indicate that the contribution of direct interaction is less than 0.3% of the total cross section for the nuclei studied. (auth)

8067 LARGE ANGLE STRIPPING ANGULAR DISTRIBUTION FITTING. D. A. Bromley, J. A. Kuehner, and E. Almqvist (Chalk River, Canada). p.349-52 of "Proceedings of the International Conference on Nuclear Structure."

While plane wave stripping formalism reproduces the diffraction structure observed in stripping angular distributions, the predicted envelope of this structure decreases much more rapidly with increasing angle than is observed experimentally. It was observed that $Si^{28}(d,p)Si^{29}$ and $Al^{27}(d,p)Al^{28}$ data for both $l = 0$ and $l = 2$ are well fitted at large angles if a constant momentum transform of the deuteron wave function is assumed. A number of deuteron potentials were examined; it is demonstrated that no reasonable potential will produce such a form factor. It then appears necessary to attribute the augmented large angle cross sections to distorted wave effects. (auth)

8068 DISTORTED WAVE EFFECTS IN STRIPPING. D. A. Bromley, J. A. Kuehner, and E. Almqvist (Chalk River, Canada). p.352-5 of "Proceedings of the International Conference on Nuclear Structure."

Distorted wave analysis was applied to $Si^{28}(d,p\gamma)Si^{29}$ angular correlations measured for the range Ed = 6 to 9 Mev. For D-wave neutron capture and E2 de-excitation of the 2.03 Mev state a single correlation in the reaction plane determines the statistical tensors. From these tensors the angular correlations of the 1.28 Mev state are predicted and are in accord with experiment supporting the stripping hypothesis of independence of final state nuclear structure. (auth)

8069 EFFECTS OF A RESONANCE ON DIRECT REACTIONS. B. Buck and G. R. Satchler (Oak Ridge National Lab., Tenn.). p.355-7 of "Proceedings of the International Conference on Nuclear Structure."

The effect on a direct reaction of a compound nucleus resonance was studied. Two resonance effects are considered: first, interference between the resonant and direct amplitudes, and second, a resonant elastic distortion in the waves used to calculate the direct amplitude itself. In $C^{12}(d,p)C^{13}$ at 4 Mev the latter is found to have negligible effect on differential cross section and polarization. (auth)

8070 DIRECT-INTERACTION CONTRIBUTION TO 3-MEV NEUTRON INELASTIC SCATTERING FROM Fe AND Pb. Lawrence Cranberg (Los Alamos Scientific Lab., N. Mex.) and Norman K. Glendenning. p.357-9 of "Proceedings of the International Conference on Nuclear Structure."

The presence of direct interactions in neutron inelastic scattering appears to begin to contribute to the excitation of the first states in Fe^{56} and Pb^{206} at 3 Mev. The angular distributions show a small preference for forward-hemisphere scattering compared to symmetric distributions at

2.2 Mev. The direct-interaction theory is in qualitative (though not detailed) agreement with the nonsymmetric component. (auth)

8071 THE NEUTRON YIELD FROM THE $C^{13}(p,n)N^{13}$ REACTION. P. Dagley, W. Haeberli, J. X. Saladin, and R. R. Borchers (Univ. of Wisconsin, Madison). p.359-61 of "Proceedings of the International Conference on Nuclear Structure."

The 0° cross section for the $C^{13}(p,n)N^{13}$ reaction was measured from threshold to 13.1 Mev and 50 angular distributions were determined in the same range. The yield at 90° was measured up to 5.3 Mev. The angular distributions show strong similarities and the results are discussed in terms of compound nucleus and direct interaction processes. (auth)

8072 ANALYSIS OF ENERGY LEVELS IN Na^{24}. F. A. El-Bedewi and M. A. El-Wahab (Atomic Energy Establishment, Cairo, U.A.R.). p.362-4 of "Proceedings of the International Conference on Nuclear Structure."

A thin layer of sodium was bombarded by a collimated deuterium beam. The angular distributions and energy of the protons from the ground state and various levels in Na^{24} were determined. Energy transitions and the parity and spin of the energy levels are discussed. (M.C.G.)

8073 (d,n) STRIPPING STUDIES ON B^{10} AND B^{11}. A. J. Ferguson, H. E. Gove, A. E. Litherland, and R. Batchelor (Chalk River, Canada). p.364-6 of "Proceedings of the International Conference on Nuclear Structure."

The 6.50-Mev level of C^{11} and the 15.1-Mev level of C^{12} were studied through (d,n) stripping reactions on B^{10} and B^{11}. In both cases, P-wave patterns were observed indicating negative parity for the states. The proton reduced width of the 15.10-Mev level of C^{12} was found to be the order of magnitude of the single particle width. (auth)

8074 ANGULAR DISTRIBUTIONS AND POLARIZATION IN DIRECT REACTIONS. L. J. B. Goldfarb and R. C. Johnson (Univ. of Manchester, Eng.). p.367-8 of "Proceedings of the International Conference on Nuclear Structure."

General expressions were found for angular distributions and polarization for a variety of processes including the stripping of deuterons and heavier particles and inelastic scattering. Use is made of the distorted-wave Born approximation with spin-dependent distortion. The case $l = 0$ leads to selection rules for polarization depending on the nature of the spin-dependence of the distortion. (auth)

8075 COULOMB EFFECTS IN THE DIRECT INTERACTION. N. M. Hintz (Inst. for Theoretical Phys., Copenhagen, Denmark). p.368-70 of "Proceedings of the International Conference on Nuclear Structure."

A direct-interaction model is used to calculate $\sigma(p,p')/\sigma(p,n)$ for events which leave the nucleus in a state with excitation, $E \leq 8$ Mev. By including coulomb forces in the interaction the high experimental ratio of inelastic protons to neutrons can be partially understood. The relative importance of coulomb effects in the direct interaction is shown to increase with increasing bombarding energy. (auth)

8076 REDUCED WIDTH EXTRACTION FROM STRIPPING DATA. J. A. Kuehner, E. A. Almqvist, and D. A. Bromley (Chalk River, Canada). p.375-8 of "Proceedings of the International Conference on Nuclear Structure."

Reduced widths were extracted from the experimental data on the $Si^{28}(d,p)Si^{29}$ reaction using four separate techniques to examine their relative validity. These were fitting the absolute total cross section, fitting the differential cross section in the region of the stripping maximum, extrapolating the differential cross section information to the pole of the plane wave formalism as suggested by Amado, and examining the ratio of coefficients of Legendre polynomial expansions fitted to both experimental and plane wave theoretical differential cross sections as functions of the polynomial order as suggested by Bowcock. All results lie within a factor of 2 providing further justification for use of the simple peak fitting procedure. (auth)

8077 INTERFERENCE EFFECTS IN STRIPPING. J. A. Kuehner, E. Almqvist, and D. A. Bromley (Chalk River, Canada). p.378-81 of "Proceedings of the International Conference on Nuclear Structure."

High resolution studies, on the $Si^{28}(d,p)Si^{29}$ reactions for $6 \leq E_d \leq 11$ Mev, demonstrated pronounced interference structure in proton differential excitation curves for both S and D wave neutron capture situations. Corresponding proton angular distributions established a dominant direct interaction mechanism; the interference (involving direct and compound system amplitudes) did not appear in the total excitation curve. Relative reaction intensities of >85% and <15% were established for the direct and compound system contributions in this energy range. The total excitation curves are well fitted by a simple, plane-wave Butler formalism. (auth)

8078 A SIMPLE TREATMENT OF NUCLEAR DIRECT INTERACTION PROCESSES. I. E. McCarthy and D. L. Pursey (Univ. of California, Los Angeles). p.381-4 of "Proceedings of the International Conference on Nuclear Structure."

Physical arguments are used to predict the effect on various differential cross sections of distortion of the wave functions used in the distorted wave Born approximation treatment of direct interactions. A simple but fairly realistic model for α-particle wave functions gives reasonable agreement with observed cross sections for (α,α') scattering. (auth)

8079 DETERMINATION OF NUCLEAR SURFACE PARAMETERS BY MEANS OF THE ELASTIC SCATTERING OF LIGHT NUCLEI. J. A. McIntyre, K. H. Wang, and S. D. Baker (Yale Univ., New Haven, Conn.). p.384-7 of "Proceedings of the International Conference on Nuclear Structure."

The elastic scattering processes, $Pb^{208}(O^{16}, O^{16})Pb^{208}$ and $Tb^{159}(F^{19}, F^{19})Tb^{159}$, were studied experimentally. An analysis of the experimental data using a smoothed modification of the Blair sharp cut-off approximation showed that the nuclear surface "thickness" is approximately three times as large for the Tb^{159} case as for the Pb^{208} case. (auth)

8080 DISTORTED WAVE BORN CALCULATION FOR INELASTIC SCATTERING OF 14 MEV NEUTRONS. Francis G. J. Perey (Univ. of Montreal, Canada and Oak Ridge National Lab., Tenn.). p.387-91 of "Proceedings of the International Conference on Nuclear Structure."

The inelastic differential cross sections for the scattering of 14-Mev neutrons from the first levels of C^{12}, O^{16}, and Li^7 were measured. The differential cross sections were calculated using the distorted wave Born approximation. It was possible to find very good agreement with the shape of the experimental cross sections using a reasonable set of optical potential parameters. The results of the calculations using square-well and rounded-edge potentials are presented. (auth)

8081 COLLECTIVE EFFECTS IN INELASTIC SCATTERING. W. T. Pinkston and G. R. Satchler (Oak Ridge National Lab., Tenn.). p.394-6 of "Proceedings of the International Conference on Nuclear Structure."

Inelastic scattering is closely analogous to an electric multipole radiative transition, and shows similar collective enhancement. Spin-flip transitions were little affected for the enhancement was found in the non-spin-flip amplitudes. Such enhancement modifies the conclusions drawn about angular momentum coupling in the target nucleus, especially in the p-shell, since these depend upon the ratio of spin-flip to non-flip. (auth)

8082 STRIPPING REACTIONS OF LOW Q-VALUE. J. P. F. Sellschop and D. W. Mingay (Harwell, England). p.396-9 of "Proceedings of the International Conference on Nuclear Structure."

Differential cross sections for the reactions $C^{12}(d,p)C^{13*}$ (3.09 Mev-level) and $Li^7(d,p)Li^8$ (ground state) were measured for incident deuteron energies between 2.0 and 4.0 Mev. Angular distributions measured at low deuteron energies are extremely well fitted using the pure stripping formalism of Butler, the close agreement being attributed to the small Q values of the reactions. (auth)

8083 POLARIZATION OF PROTONS FROM THE $B^{10}(d,p)B^{11}$ (gnd) AND $Ca^{40}(d,p)Ca^{41}$ (gnd) REACTIONS. Chuin Hu and Noriaki Takahashi (Osaka Univ., Japan). p.400-2 of "Proceedings of the International Conference on Nuclear Structure."

The polarization of protons from $B^{10}(d,p)B^{11}$ (gnd) and $Ca^{40}(d,p)Ca^{41}$ (gnd) reactions was measured, using the 11.4-Mev deuterons. The emitted proton energies were reduced to 15 Mev in order to use the ~55% polarization of carbon at 45°, and the detection of protons was made with NaI crystals. The negative polarizations observed were contrary to those expected from the Newns theory. (auth)

8084 NUCLEI IN THE 1p SHELL AND NEAR CLOSED SHELLS. E. B. Paul. p.403-18 of "Proceedings of the International Conference on Nuclear Structure."

A review of experimental data collected on the p-shell is presented. The level spectra of odd A, even-even, and odd-odd nuclei are discussed. Angular distributions from $B^{10}(d,n)C^{11}$ and $Be^9(t,p)Be^{11}$ reactions, energy levels for N^{17}, and cross sections for $O^{18}(t,\alpha)N^{17}$ reactions are given. The fit of dispersion calculations to experimental data is shown. Some recently developed nuclear modes are also discussed. (M.C.G.)

8085 THE SHELL MODEL AND ITS EFFECTIVE NUCLEAR FORCES. J. P. Elliott. p.419-28 of "Proceedings of the International Conference on Nuclear Structure."

The shell model, its applications, and results obtained from it are compared with the model arising from the concept of a nonspherically symmetric field and the cluster model. The determination of an effective nuclear force was found to depend on the calculation of the wave function. The use of the shell model in making these calculations is discussed. (M.C.G.)

8086 QUASI-FREE SCATTERING OF PROTONS. G. Jacob. p.429-37 of "Proceedings of the International Conference on Nuclear Structure."

Experimental results for (p,2p) reactions are presented for energies of 185 and 440 Mev. Cross sections and angular distributions are given for targets of Na^{23}, C^{12}, Li^7, and He^4. For processes in which both protons emerged at certain angles, the large total distance the participating nucleons had to travel in the nucleus limited the effective interaction to a very specific region of the nuclear surface. (M.C.G.)

8087 SYSTEMATICS OF NUCLEI BETWEEN O^{16} AND Ca^{40}. H. E. Gove. p.438-60 of "Proceedings of the International Conference on Nuclear Structure."

The systematics in the region of the periodic table between O^{16} and Ca^{40} are outlined. Nuclear binding energies and variations of properties of the ground state, such as the dipole and quadrupole moment, through the 1d-2s shell are discussed. The properties of excited states of nuclei in the 1d-2s shell are reviewed. (M.C.G.)

8088 INTERMEDIATE COUPLING CALCULATIONS IN THE 2s-1d SHELL. M. K. Banerjee. p.461-7 of "Proceedings of the International Conference on Nuclear Structure."

A new method of doing intermediate-coupling shell model calculations in the s-d shell was developed. Preliminary results were obtained for calculations of the level spacings of Mg^{24}. A first-order calculation indicated that there is very little band mixing. The moment of inertia for nuclei with more than four particles in the s-d shell was fairly constant. (M.C.G.)

8089 AN INVESTIGATION OF THE LEVELS OF P^{30}. E. Baart, L. L. Green, and J. C. Willmott (Univ. of Liverpool, England). p.468-9 of "Proceedings of the International Conference on Nuclear Structure."

A study of the energy levels of P^{30} was made using the $Si^{29}(p,\gamma)P^{30}$ reaction. Large sodium iodide crystals were used as detectors. Decay schemes were deduced, and spins and parities were assigned on the basis of angular distribution and triple correlation experiments. Comparison is made with the predictions of the Unified Model, but with very little success. (auth)

8090 EXCITED STATES OF N^{16} AND F^{16}. T. W. Bonner, E. A. Davis, G. Din, and H. M. Kuan (Rice Univ., Houston, Tex.). p.470-1 of "Proceedings of the International Conference on Nuclear Structure."

Excited states in N^{16} at 1.29 and 1.71 Mev were observed in the nuclear reaction $F^{19}(n,\alpha)N^{16}$. Corresponding levels in F^{16} at 0.88 and 1.26 Mev were observed in the reaction $N^{14}(He^3,n)F^{16}$. Apparently these states are in addition to the negative parity states calculated by Elliott and Flowers. (auth)

8091 STUDY OF LOW LEVELS IN EVEN-EVEN NUCLEI OF THE 1d-2s SHELL. C. Broude and H. E. Gove (Chalk River, Canada). p.471-4 of "Proceedings of the International Conference on Nuclear Structure."

Levels were excited by inelastic scattering of protons from the Chalk River tandem accelerator. Angular correlations were measured on the γ cascades from these levels through the first excited state to enable the assignment of spins. The energies of the levels studied, in Mev, are: Ne^{20}(4.25, 4.97), Mg^{24}(5.22, 6.01), Mg^{26}(2.97, 3.61, 3.97, 4.35), Si^{28}(4.62, 4.98, 6.28), Si^{30}(3.51, 3.79), and S^{32}(3.78, 4.29, 4.47, 5.01). Analysis of the results is proceeding. (auth)

8092 NEUTRON SCATTERING FROM CLOSED SHELL NUCLEI. J. L. Fowler, E. G. Corman, and E. C. Campbell (Oak Ridge National Lab., Tenn.). p.474-7 of "Proceedings of the International Conference on Nuclear Structure."

The role of phase shifts of neutron scattering used in combination with bound state information in defining phenomenological nuclear potentials is illustrated for the case of O^{16}. Various forms of the potential were compared. Data on the total neutron cross section of Pb^{208} from 0.55 to 4.32 Mev showed up a great many new resonances. (auth)

8093 REDUCED WIDTHS AND ISOTOPIC SPIN IMPURITY OF THE $\frac{1}{2}^+$ STATES OF N^{15}. J. B. French (Univ. of Pittsburgh, Penna.) S. Iwao, and E. Vogt. p.480-2 of "Proceedings of the International Conference on Nuclear Structure."

The nuclear reactions of C^{14} + p involve the interference of two adjacent $\frac{1}{2}^-$ levels of different isotopic spin (T = $\frac{1}{2}$ and T = $\frac{3}{2}$). A careful multilevel analysis of the cross sections yielded reduced width amplitudes and a direct estimate (4%) of the isotopic spin impurity of the levels—in moderate agreement with the results of intermediate-coupling shell-model calculations. (auth)

8094 PROPERTIES OF Be^{11}. S. Hinds, A. E. Litherland, R. Middleton, and D. J. Pullen (Aldermaston, England). p.486-8 of "Proceedings of the International Conference on Nuclear Structure."

The levels of Be^{11} were studied by means of the $Be^9(t,p)Be^{11}$ reaction. The Q-value for the reaction was found to be -1.164 ± 0.015 Mev. Excited states of Be^{11} at 0.319 ± 0.010 and 1.78 ± 0.02 Mev were found, the latter having a directly measured width of 110 ± 15 kev. Some new evidence for an even parity assignment to the ground state of Be^{11} is discussed. (auth)

8095 A DOUBLET AT 3.40 Mev EXCITATION IN Mg^{25}. S. Hinds, A. E. Litherland, and R. Middleton (Aldermaston, England). p.489-91 of "Proceedings of the International Conference on Nuclear Structure."

The well known 3.40-Mev level in Mg^{25} was studied by means of the $Mg^{24}(d,p)Mg^{25}$ and the $Al^{27}(d,\alpha)Mg^{25}$ reactions and shown to consist of two components at excitation energies of 3.398 ± 0.007 and 3.407 ± 0.007 Mev. The relative intensities of the components suggest that the upper member is the well known $\frac{3}{2}$-state and the lower member probably is $\frac{9}{2}+$. (auth)

8096 ENERGY LEVELS OF N^{17}, O^{18}, AND O^{20}. Nelson Jarmie and M. G. Silbert (Los Alamos Scientific Lab., N. Mex.). p.491-4 of "Proceedings of the International Conference on Nuclear Structure."

Study of the charged particles produced by triton bombardment of oxygen targets led to measurements of the mass of N^{17}(17.013856 ± 0.000017 amu) and O^{20}(20.010430 ± 0.000017 amu). The following previously unreported energy levels were observed: in O^{18}, 3.639 ± 0.015 and 4.457 ± 0.015 Mev; in O^{20}, 1.682 ± 0.020, 4.091 ± 0.025, and 4.449 ± 0.025 Mev. (auth)

8097 THE FINE STRUCTURE OF THE PHOTO-PROTON ENERGY SPECTRUM AND THE NUCLEAR LEVELS OF Li^6. A. P. Komar (Physical-Technical Inst. of the Academy of Sciences, Leningrad, U. S. S. R.). p.494-7 of "Proceedings of the International Conference on Nuclear Structure."

The energy distribution of protons from (γ,p) and (γ,n) reactions with Li^6 was studied. Results indicated that the reactions proceed through the formation of the unstable nuclei He^5 and Li^5. The disintegration of the Li^5 nucleus into a proton and α particle was responsible for the production of protons with an energy of 1.44 Mev. (M.C.G.)

8098 M1 TRANSITION IN V^{51} AND CONFIGURATION MIXING. Toshiya Komoda (Tokyo Inst. of Tech., Japan). p.498-9 of "Proceedings of the International Conference on Nuclear Structure."

The M1 transition probability of the 0.321-Mev level of V^{51} was calculated on the basis of configuration mixing. The calculated values are satisfactory in comparison with the experimental value which was recently measured by Delyagin and Preisa. For justification of this standpoint, the magnetic moment of V^{51} was calculated. The result is almost in agreement with the experimental value. (auth)

8099 POSITIVE-PARITY STATES IN MASS-13 NUCLEI. D. Kurath and R. D. Lawson (Argonne National Lab., Ill). p.500-2 of "Proceedings of the International Conference on Nuclear Structure."

The strength of coupling between the positive-parity nucleon and the C^{12} core was investigated. Strong coupling, as implied by using the Nilsson model to generate wave functions, contradicts experiment. A reasonable picture arises from weak coupling with a strength consistent with that derivable from summing the two-body interaction integrals between the positive-parity nucleon and the core. (auth)

8100 NUCLEAR COUPLING SCHEMES WITH S-STATE INTERACTIONS. S. A. Moszkowski (Univ. of California, Los Angeles). p.502-5 of "Proceedings of the International Conference on Nuclear Structure."

It may be that two-body interactions acting only in S-states of relative motion can give rise to observed features of nuclear coupling schemes. A purely attractive long-range S-state interaction gives spectra similar to that resulting from contact interactions. An additional repulsion at short distances can lead to collective effects even without any interactions in $l \neq 0$ states. (auth)

8101 SOME PROPERTIES OF THE LOW-LYING LEVELS OF C^{11} OBTAINED FROM $B^{10}(d,n\gamma)C^{11}$. G. C. Neilson, W. K. Dawson, and J. T. Sample (Univ. of Alberta, Edmonton, Canada). p.505-8 of "Proceedings of the International Conference on Nuclear Structure."

Information concerning the first four excited states of C^{11} was obtained through neutron angular distributions and n-γ correlations. The intensity of the group leaving C^{11} in the 1.99-Mev state was anomalously low; spin reversal may be involved. The other states showed no unusual behavior, except perhaps for the good agreement between stripping theory and the angular distribution of the group leaving C^{11} in the 6.50-Mev state. (auth)

8102 THE LOW LEVELS IN Si^{28} AND P^{29}. K. Okano, T. Tabata, and K. Fukuda (Kyoto Univ., Japan). p.508-10 of "Proceedings of the International Conference on Nuclear Structure."

The low levels in Si^{28} and P^{29} were studied by the proton capture reactions on Al^{27} and Si^{28}. The decay schemes and spins were determined for some of the levels, including the 2nd level in Si^{28}(4+) and the 1st ($\frac{3}{2}$+), 2nd ($\frac{5}{2}$+), and 4th ($\frac{5}{2}$+) levels in P^{29}. The results obtained support the recent collective model interpretation of excited states in these nuclei. (auth)

8103 THE SIGNIFICANCE OF THE GENERALIZED DENSITY OF STATES FUNCTION FOR NUCLEAR SPECTRA. G. C. Phillips and L. C. Biedenharn (Rice Univ., Houston, Tex.). p.511-13 of "Proceedings of the International Conference on Nuclear Structure."

The treatment of three-body decay processes is considered in the light of the cluster model as a succession of two-body reactions. The derived spectral shape is largely determined by a generalized density of states function that may be related to observable two-body phase shifts for the final unstable system, and to the volume of the reaction. (auth)

8104 SINGLE PARTICLE LEVELS IN N^{16} FROM SCATTERING OF FAST NEUTRONS BY N^{15}. C. P. Sikkema and R. van Wageningen (State Univ., Groningen, Holland). p.513-16 of "Proceedings of the International Conference on Nuclear Structure."

Levels in N^{16} between 4.3 and 5.8-Mev excitation were studied by analyzing data obtained in elastic n- N^{15} scattering. At about 5.0 Mev, two broad single-particle levels were found, with $J^\pi = 1^-$ and 2^-. These were identified

with the $(1p_{\frac{1}{2}})^{-1}$ $1d_{\frac{5}{2}}$ ($J^{\pi} = 1^-$ and 2^-) states expected at about the same energy. In addition, 6 narrower levels are reported. (auth)

8105 ISOBARIC SPIN SELECTION RULES AS DEMONSTRATED IN THE $Mg^{24}(\alpha,\gamma)Si^{28}$ REACTION. P. J. M. Smulders, P. B. Smith, and P. M. Endt (Rijkuniversiteit, Utrecht, Holland). p.516-18 of "Proceedings of the International Conference on Nuclear Structure."

Spectra and angular distributions of the γ radiation from eight resonances ($E_\alpha = 1.8-3.3$ Mev) in the $Mg^{24}(\alpha,\gamma)Si^{28}$ reaction were measured. Four of these resonances had $J^{\pi} = 2^+$ and three had $J^{\pi} = 4^+$. They decayed by almost pure E2 transitions. This demonstrated the strong suppression of dipole radiation in the self-conjugated nucleus Si^{28}. (M.C.G.)

8106 CONFIGURATION MIXING AND THE EFFECTS OF DISTRIBUTED NUCLEAR MAGNETIZATION ON HYPERFINE STRUCTURE IN ODD A NUCLEI. H. H. Stroke and R. J. Blin-Stoyle (Massachusetts Inst. of Tech., Cambridge). p.518-21 of "Proceedings of the International Conference on Nuclear Structure."

The effect of nuclear moment (μ) distribution on hfs (ϵ) was calculated by using the configuration-mixing theory of Blin-Stoyle, Arima, and Horie. The necessary electron solutions of the Dirac equation were obtained for a Hofstader charge distribution. Generally, the theory agreed with experiment. The formalism also permitted a semiphenomenological treatment whereby the dominant admixtures were deduced from the experimental values of μ and ϵ. (auth)

8107 O^+ SECOND EXCITED STATE OF S^{32}. T. Wakatsuki, Y. Hirao, E. Okada, and I. Miura (Osaka Univ., Japan). p.521-4 of "Proceedings of the International Conference on Nuclear Structure."

By the analysis of γ rays from the reaction $S^{32}(p,p'\gamma)$, it was concluded that the spin and parity of the second excited state of S^{32} is O^+. The cascade γ rays from the second excited state were shown to be isotropic and γ-γ correlation to have the pattern $O^+(E2)2^+(E2)O^+$. (auth)

8108 NUCLEAR COUPLING SCHEMES AND THE MICROSCOPIC DESCRIPTION OF COLLECTIVE EFFECTS. B. R. Mottelson. p.525-46 of "Proceedings of the International Conference on Nuclear Structure."

The present status of efforts to describe nuclear collective effects in terms of shell model coupling schemes is reviewed. Two different types of correlation between the nucleons in the nucleus were found: a tendency for each nucleon to adjust its motion to the shape of the average field produced by all the other nucleons and the pairing effects from short-range forces. The ways these correlations affect the properties of the nucleus are discussed. The different types of collective vibrations and their causes are outlined. (M.C.G.)

8109 PARTICLE STATES IN STRONGLY DEFORMED NUCLEI. I. Perlman. p.547-62 of "Proceedings of the International Conference on Nuclear Structure."

The regions in the system of nuclei where all species have a marked deviation from spherical symmetry were investigated. Electric quadrupole Coulomb excitation showed that the characteristic rapid electric quadrupole transitions may be enhanced more than 100-fold over the expectations for a single proton as the radiator. Nucleon orbitals were successfully characterized on the basis of independent particle motion in an axially-symmetrical potential. A brief review of experimental data is included. (M.C.G.)

8110 COULOMB EXCITATION OF VIBRATIONAL LEVELS. B. Elbek. p.563-7 of "Proceedings of the International Conference on Nuclear Structure."

Recent experiments on Coulomb excitation of vibrational levels in heavy deformed nuclei are reviewed. The electron spectrum of Th^{232} was interpreted in terms of monopole-enhanced transitions from a 2^+ β-vibrational state at 775 kev, proceeding to the 2^+ level in the ground state band. The Coulomb excitation of negative parity states in uranium and thorium and the multipolarity of the de-excitation were studied. (M.C.G.)

8111 RADIATIVE PROPERTIES OF THE LOW LEVELS IN Cd^{114}. L. V. Groshev. p.568-72 of "Proceedings of the International Conference on Nuclear Structure."

The radiative capture of neutrons leading to excited states of Cd^{114} was re-investigated. The γ and internal conversion electron spectra were obtained. It was found that, in addition to the 2^+, 4^+, and 0^+ levels previously known, there is a new 0^+ level with an energy of 1135 kev. (M.C.G.)

8112 COMPARISON OF CAPTURE GAMMA RAY DECAY SCHEMES. G. A. Bartholomew. p.573-80 of "Proceedings of the International Conference on Nuclear Structure."

Certain anomalies were found in the ratios of intensities of competing primary γ rays of the same multipole order observed in the spectra of various heavy nuclei. The reduced widths for the strongest E1 γ rays from these elements are comparable to those of the strong γ rays in elements near iron and lead whose strengths are attributed to direct capture effects. The neutron-capture γ spectra of Gd^{156} and Gd^{158} were measured. Significant differences were found, both in the groups of lines at 1 Mev and in the high-energy spectra. Energy level schemes based on transition energy systematics and coincidence measurements are shown. (M.C.G.)

8113 DECAY SCHEME OF E^{253}. F. Asaro, S. G. Thompson, F. S. Stephens, and I. Perlman (Univ. of California, Berkeley). p.581-4 of "Proceedings of the International Conference on Nuclear Structure."

The α decay of Es^{253} leads to the identification in terms of the Nilsson model of three intrinsic Bk^{249} states. Twelve α groups of Es^{253} were observed corresponding to three rotational bands based upon states at 0 kev, $\frac{7}{2}$+ (633); 9 kev, $\frac{3}{2}$− (521); and 393 kev, $\frac{5}{2}$+ (642). The rotational level spacings are interpreted in terms of the coriolis interaction. (auth)

8114 AN EXTENSION OF THE SHELL MODEL FOR HEAVY SPHERICAL NUCLEI. Michel Baranger (Carnegie Inst. of Tech., Pittsburgh). p.584-6 of "Proceedings of the International Conference on Nuclear Structure."

The Bardeen-Bogoliubov-Belyaev treatment of pairing correlations was applied to spherical nuclei with a general nuclear force. The interaction between quasi-particles was treated by the method of linearized equations of motion. The method held both for collective and single-particle excitations. It is at least as powerful as other treatments of collective effects starting from the shell model. (auth)

8115 ON THE NATURE OF THE FIRST 2+ LEVEL OF EVEN-EVEN SPHERICAL NUCLEI. S. T. Belyaev. p.587-9 of "Proceedings of the International Conference on Nuclear Structure."

The nature of the first excited states of even-even nu-

clei was investigated as a spectrum of collective oscillations when the 2+ level corresponds to a single phonon excitation. The microscopic structure of these oscillations was investigated in order to establish the connection with the "single-particle" description. It was found that the 2+ state is a paired state of a particle in a hole. (M.C.G.)

8116 MAGNETIC DIPOLE TRANSITION PROBABILITIES IN SOME ODD-A ROTATIONAL NUCLEI. A. E. Blaugrund, Y. Dar, and G. Goldring (Weizmann Inst., Rehovoth, Israel). p.590 of "Proceedings of the International Conference on Nuclear Structure."

Measurements of lifetimes of first excited states in some odd-A rotational nuclei are reported. The B(M1) values for the transitions investigated were compared with B(M1) values for higher transitions in the same nuclei. The ratios of B(M1) values for the two transitions were compared with the predictions of the collective rotation theory. (auth)

8117 NUCLEAR STRUCTURE STUDIES IN THE TIN ISOTOPES WITH (d,p) AND (d,t) REACTIONS. B. L. Cohen and R. E. Price (Univ. of Pittsburgh, Penna.). p.591-2 of "Proceedings of the International Conference on Nuclear Structure."

The neutron single particle states in the odd isotopes of tin were identified by (d,p) angular distribution studies. The cross sections for exciting these by (d,p) and (d,t) reactions determined the V_j^2 (fraction by which state is full) for each subshell in each isotope. These agreed reasonably well with V_j^2 calculated from observed energies, but some discrepancies are noted and explanations are offered. (auth)

8118 SPINS OF THE ISOMERIC STATES OF Hf^{178} AND Hf^{180}. M. Deutsch and R. W. Bauer (Massachusetts Inst. of Tech., Cambridge). p.592-3 of "Proceedings of the International Conference on Nuclear Structure."

Angular correlations and internal conversion unambiguously establish J = 8(—) for both states of Hf^{178} and Hf^{180}. (auth)

8119 EFFECTS OF PAIR CORRELATION NEAR CLOSED SHELLS. S. I. Drozdov, D. F. Zaretskii, and A. B. Migdal. p.593-4 of "Proceedings of the International Conference on Nuclear Structure."

In order to investigate the effects of pair correlations in the nucleus, it was assumed that the part of the interaction between nucleons which does not lead to pairing gives a contribution to the self-consistent field and to the effective mass. The Bardeen hamiltonian was solved for the density matrix and excitation spectrum of the nuclei. (M.C.G.)

8120 ANOMALOUS CONVERSION COEFFICIENTS IN Hf^{180m}, W^{182}, AND Re^{187}. W. Farrell Edwards and F. Boehm (Utah Univ., Salt Lake City). p.598-600 of "Proceedings of the International Conference on Nuclear Structure."

A calibration of the bent crystal diffraction γ-ray spectrometer relative intensity scale was performed and an accuracy of 1 or 2% in the comparison of intensities of lines differing in energy by a factor as large as 2.5 is now attainable. By comparing the observed relative intensities of γ-ray lines with relative intensities of corresponding conversion electron lines measured with a precision magnetic spectrometer, precise absolute conversion coefficients were derived for several transitions in Hf^{180}, W^{182}, and Re^{187}. (auth)

8121 ON THE CORRELATION BETWEEN THE NUCLEAR DEFORMATION AND THE MOMENT OF INERTIA. B. Elbek (Inst. for Theoretical Phys., Univ. of Copenhagen, Denmark). p.601-3 of "Proceedings of the International Conference on Nuclear Structure."

Recent data from lifetime measurements and Coulomb excitation yielded accurate information on the nuclear deformation. A strong correlation between the deformation and the nuclear moment of inertia was found, but the correlation was different for the rare earths and for the heavy elements. A new method developed by Glendenning and Sawicki for determination of the deformation seems to bring all data in agreement. (auth)

8122 RELATIVE TRANSITION PROBABILITIES IN Dy^{160}. G. T. Ewan, R. L. Graham, and J. S. Geiger (Chalk River, Canada). p.603-5 of "Proceedings of the International Conference on Nuclear Structure."

The relative transition probabilities from positive and negative parity levels in Dy^{160} were determined in a high resolution study of the decay of Tb^{160}. Comparison of these measurements with the theoretical predictions of the Unified Model shows that appreciable band mixing is required in order to obtain quantitative agreement. The E2 transition probabilities from the positive parity levels also agree with the predictions of the Davydov and Fillipov model. (auth)

8123 STUDY OF SOME ISOMERIC STATES IN THE RARE EARTH REGION AND OF SOME DOUBLE ISOMERIC NUCLEI. P. F. Fettweis (Centre d'Etudes Nucléaires, Mol, Belgium). p.606-9 of "Proceedings of the International Conference on Nuclear Structure."

Some recently discovered isomeric states were investigated. A close correlation was found between the double isomeric nuclei In^{114}, In^{116}, Ir^{192}, and Ir^{194}. Isomeric states in Yb^{169}, Yb^{175}, and Yb^{177} can be explained in terms of the Nilsson level schemes. A close correlation with neighboring odd-neutron nuclei was also found. (auth)

8124 EVIDENCE FOR A K = 0 ROTATIONAL BAND IN Ho^{166}. J. S. Geiger, R. L. Graham, and G. T. Ewan (Chalk River, Canada). p.610-12 of "Proceedings of the International Conference on Nuclear Structure."

The properties of levels in Ho^{166} excited in the β-decay of 81-hr Dy^{166} were studied using the Chalk River $\pi\sqrt{2}$ spectrometer. The transition intensities between levels at 0 kev 0-, 54.22 kev 2-, and 82.45 kev 1- indicated a common K = 0 assignment. These three levels form a K = 0 rotational band in which the odd spin member is displaced relative to the even spin members. (auth)

8125 ON THE VIBRATIONAL LEVELS OF NUCLEI. B. T. Geilikman. p.612-14 of "Proceedings of the International Conference on Nuclear Structure."

In order to calculate the mass coefficients of quadrupole vibrations, the model of the isotropic oscillator was used with a few additional terms. Only a small correction was found necessary for transitions within the shells. (M.C.G.)

8126 COMPARISON BETWEEN THE MODEL OF NUCLEAR QUADRUPOLE EXCITATIONS (VKV-MODEL) AND THE MODEL OF DAVYDOV AND FILLIPOV (NON-AXIAL ROTATOR) FOR NUCLEI WITH EQUI-DISTANT ENERGY SPECTRA. D. P. Grechushina. p.614-16 of "Proceedings of the International Conference on Nuclear Structure."

Two models used to describe the properties of the levels of even-even nuclei are compared. The models are those of quadrupole vibrational excitations and of rigid, nonaxial rotator. Calculated values for transition probabilities, quadrupole moments, shifts of electron levels, and E0 transitions were obtained using each model and compared. (M.C.G.)

8127 MOMENTS OF INERTIA OF ODD NUCLEI. Yu. T. Grin', S. I. Drozdov, and D. F. Zaretskii (U.S.S.R.). p.616-17 of "Proceedings of the International Conference on Nuclear Structure."

The method developed by Migdal to calculate the moment of inertia of even nuclei was adapted to determine the moment of inertia for odd nuclei. The Green's function for a finite system with an odd number of particles was obtained. (M.C.G.)

8128 ON THE BETA DECAY SYSTEMATICS OF Hg–Tl ISOTOPES. R. K. Gupta and S. Jha (Tata Inst., India). p.617-20 of "Proceedings of the International Conference on Nuclear Structure."

The results of the decay-energy measurement of thallium isotopes are reported. The β-decay systematics (plotted according to Way and Wood) show a break at neutron number 120. These systematics were used to calculate probability for α decay of Pb^{210}. A possible method for detecting an α branch in Pb^{210} is suggested. (auth)

8129 191 KEV TRANSITION IN Au^{197}. M. C. Joshi and B. V. Thosar (Tata Inst., Bombay, India). p.623-5 of "Proceedings of the International Conference on Nuclear Structure."

Gamma-transitions in Au^{197} were studied in a β-ray spectrometer, using e^--γ and β-γ coincidence measurements. The K-conversion coefficient for 191 kev transitions was determined from the γ spectrum in coincidence with L-conversion electrons of 77 kev γ ray. The value for α_K was found to be 2.0 ± 0.5, which is interpreted as due to an $M_1 + E_0$ type of transition; the 268 kev level had spin $\frac{1}{2}$ and even parity. (auth)

8130 CALCULATION OF CERTAIN PROPERTIES OF WEAKLY DEFORMED NUCLEI. V. D. Konstantinov, A. M. Korolev, V. I. Ovcharenko, and Yu. L. Gurin. p.625-9 of "Proceedings of International Conference on Nuclear Structure."

Magnetic and quadrupole moments of weakly deformed nuclei were calculated, taking into account collective effects. Values were obtained for Sr^{87}, Zr^{91}, Mo^{95}, Ba^{135}, Ba^{137}, Nd^{143}, Nd^{145}, Hg^{199}, Hg^{201}, Pb^{207}, Co^{59}, Cu^{63}, In^{115}, Sb^{121}, Tl^{203}, and Bi^{209}. It was found that the Bohr model gives fairly good results when the collective effects are taken into account. (M.C.G.)

8131 VARIATION OF NUCLEAR MOMENTS OF INERTIA WITH DEFORMATION. N. MacDonald (Aldermaston, England). p.630-2 of "Proceedings of the International Conference on Nuclear Structure."

The dependence of nuclear moments of inertia on β is discussed in connection with the improvement of the hydrodynamical estimate of the rotation-vibration correction to rotational energies and the explanation, in terms of an asymmetric nucleus, of the empirical rule $B(E2) \propto E_2^{-m}$ ($m \sim 1.2$) for the first excited state of many even nuclei. In particular, Sm^{152}, tungsten, and osmium were studied. (auth)

8132 EVIDENCE FOR THE EXISTENCE OF ROTATIONAL LEVELS IN EVEN-EVEN NUCLEI. C. A. Mallmann (Argonne National Lab., Ill.). p.632-5 of "Proceedings of the International Conference on Nuclear Structure."

A theory of rotations of even-even nuclei was developed which is more general than the one based on the hydrodynamical model. It was assumed that the rotational motion can be treated adiabatically and that the three effective moments of inertia and the two effective quadrupole moments are independent parameters. A small centrifugal distortion of the rotor was added as a correction term. The theoretical predictions for energy levels and γ-ray transition probabilities were compared with experimental results for nuclei with $40 \leq A \leq 250$, and good agreement was obtained. The trends of the effective moments of inertia and effective quadrupole moments as a function of A are given. (auth)

8133 NUCLEAR EFFECTS OBSERVED IN X-RAY SPECTRA. J. J. Merrill and J. W. M. DuMond (California Inst. of Tech., Pasadena). p.637-9 of "Proceedings of the International Conference on Nuclear Structure."

Measurements of the L x-ray spectra of heavy elements, W, Pt, Bi, Th, U, Np, Pu, and Am, with a precision two-crystal spectrometer are described. The possibility of detecting a nuclear size effect on the $L_{II}-L_{III}$ fine-structure splitting is discussed, and the increased widths of some lines for high atomic number are explained. First experimental evidence for an x-ray hyperfine structure line broadening attributed to the large nuclear magnetic moment of Np^{237} is presented. (auth)

8134 ROTATIONAL ENERGY LEVELS OF DEFORMED EVEN-EVEN NUCLEI. R. B. Moore and W. White (McGill Univ., Montreal, Can.). p.640-3 of "Proceedings of the International Conference on Nuclear Structure."

A digital computer was used to extend calculations of rotational energy levels of deformed even-even nuclei treated in the manner of Davydov and Filippov. A comparison was made with the high spin states of Th^{232} and U^{238} recently realized by Coulomb excitation by heavy ions. (auth)

8135 NUCLEAR LEVELS OF Sn^{118}. M. K. Ramaswamy, W. L. Skeel, D. L. Hutchins, and P. S. Jastram (Ohio State Univ., Columbus). p.643-6 of "Proceedings of the International Conference on Nuclear Structure."

Directional and polarization correlation measurements on γ rays following the decay of 5-hr Sb^{118} led to the following spin and parity assignments for levels (in Mev) in Sn^{118}: 1.22 (2^+), 2.25 (4^+), and 2.51 (5^-). The 2.55-Mev level is assigned 6^+ from log ft considerations. The most probable origins of the levels are as follows: 1.22 and 2.25 (quadrupole vibrational), 2.55 (particle excitations), and 2.51 ($\lambda = 5$, collective vibration). (auth)

8136 CONCERNING THE MAGNETIC MOMENTS OF DEFORMED NUCLEI. J. O. Rasmussen and L. W. Chiao (Univ. of California, Berkeley). p.646-9 of "Proceedings of the International Conference on Nuclear Structure."

A comparison of experimental and calculated magnetic moments of odd-A spheroidal nuclei gives strong evidence that there is a reduction of the magnitude of the effective g_s factors by ~1.5 units below the magnitudes for free nucleons. The seriousness of Coriolis interaction effects on μ for one class of nuclei is also illustrated. (auth)

8137 ENERGY LEVELS OF Fe^{57}. J. F. Vervier and G. A. Bartholomew (Chalk River, Canada). p.650-2 of "Proceedings of the International Conference on Nuclear Structure."

Angular correlation and circular polarization experiments were performed on the γ rays following neutron capture in Fe^{56}. An analysis of the decay scheme of Fe^{57} was attempted on the basis of the Nilsson model. Similar considerations were applied to the ground-state magnetic and quadrupole moments of neighboring odd-proton nuclei. (auth)

8138 MOTION OF NUCLEONS IN AN ANISOTROPIC OSCILLATOR POTENTIAL TAKING THE SPIN-ORBITAL INTERACTION INTO ACCOUNT. D. V. Volkov and E. V. Inopin (U.S.S.R.). p.652-4 of "Proceedings of the International Conference on Nuclear Structure."

Neilson's considerations of nonaxial nuclei were extended

to the general nonaxial case when all three frequencies of the oscillator potential in which the nucleon is moving are different. This problem was reduced to that of an oscillator without spin-orbital interaction. (M.C.G.)

8139 A NEW LEVEL SCHEME FOR Sr^{86}. T. Yamazaki, H. Ikegami, and M. Sakai (Univ. of Tokyo, Japan). p.654-7 of "Proceedings of the International Conference on Nuclear Structure."

Nuclear level scheme for Sr^{86} was investigated from the decay of Y^{86}. Many new complex γ rays and five positron components were observed with a β spectrometer, and coincidence study was performed. In addition to the 1.08-Mev first excited state, a new 2.25-Mev second excited state with a spin of 4 and other higher excited states were found. (auth)

8140 (d,p) AND (d,t) REACTIONS AND PAIRING PLUS QUADRUPOLE-QUADRUPOLE FORCE MODEL. Shiro Yoshida (University of Pittsburgh, Penna.). p.657-8 of "Proceedings of the International Conference on Nuclear Structure."

Cross sections for (d,p) and (d,t) reactions in units of the single particle cross sections were calculated assuming the pairing plus quadrupole-quadrupole force. The ratio of the ground state cross section odd → even-even to even-even → odd nuclei and vibrational state to the ground state were compared with experiments on the tin isotopes. Agreement was fairly good. (auth)

8141 SLOW NEUTRON RESONANCES. J. A. Harvey. p.659-75 of "Proceedings of the International Conference on Nuclear Structure."

Slow neutron resonances and excited levels in compound nuclei were investigated in the energy region just above the binding energy of the neutron. The total cross section of U^{238} as a function of neutron energy and resonance parameters of U^{238} are given. New techniques for analyzing resonances where interference is important are reviewed. The distribution of the widths of the resonance, the level spacing distribution, the s-wave strength function, and the correlation between the size of a resonance and its local spacing are discussed. (M.C.G.)

8142 STRENGTH FUNCTIONS AND GROSS STRUCTURE. J. P. Schiffer. p.676-96 of "Proceedings of the International Conference on Nuclear Structure."

Experimental information regarding the strength function for nucleons is reviewed. The ways in which various reactions can be used to study strength functions and the positions of single particle states obtained by such experiments are discussed. The density of single particle levels and the known approximate depth of the potential indicated that there is no velocity dependence in the potential for these excitation energies. Studies of the angular distribution of individual levels resolved gross structures even when they overlapped. (M.C.G.)

8143 THE COMPOUND NUCLEUS. T. Ericson. p.697-709 of "Proceedings of the International Conference on Nuclear Structure."

Typical properties of compound-nucleus reactions under various circumstances are discussed. The compound matrix-elements were found to be associated with intermediate states within the "width" due to the decay of the equilibrium system. It was postulated that in a pure compound-nucleus reaction, the cross sections to a single state should fluctuate like a Porter-Thomas distribution. These fluctuations cause the interference effects in elastic scattering and direct interactions. Experiments confirming compound-nucleus formation are described. (M.C.G.)

8144 PHOTONUCLEAR REACTIONS-EXPERIMENTAL. L. Katz. p.710-20 of "Proceedings of the International Conference on Nuclear Structure."

The gross properties of the interaction between photons and nuclei resulting in giant photonuclear resonance are discussed. The structure of the resonance cross section was studied in (γ,p) and (γ,n) reactions with O^{16}, Ne^{20}, C^{12}, and Be^{9}. Excitation of peaks in the giant photonuclear resonance region was also found in proton elastic scattering by C^{12}. (M.C.G.)

8145 THEORIES OF GIANT DIPOLE RESONANCES. J. S. Levinger. p.721-30 of "Proceedings of the International Conference on Nuclear Structure."

The current status of calculations of the absorption cross section of the giant dipole resonance as a function of photon energy and of the products of nuclear photodisintegration is reviewed. Several experimental values for photon absorption, distribution of fast photoneutrons, and photon scattering are discussed. (M.C.G.)

8146 POSITION OF THE GIANT DIPOLE RESONANCE. V. G. Shevchenko. p.731-5 of "Proceedings of the International Conference on Nuclear Structure."

In (γ,p) and (γ,n) reactions with nuclei, the position of the giant resonance was found by taking into account the individual pair interactions and using empirical values for the binding energy of the nucleons in the closed shells. Calculations were made for Ca^{40}, V^{51}, Ni^{58}, Cu^{65}, and Cu^{66}. The agreement between the calculated results and experimental data was satisfactory. (M.C.G.)

8147 SEARCH FOR PROTON SIZE RESONANCES. E. A. Almqvist, D. A. Bromley, J. A. Kuehner, and E. W. Vogt (Chalk River, Canada). p.736-9 of "Proceedings of the International Conference on Nuclear Structure."

A measure of the total proton reaction cross sections for protons ($4 \leq Ep \leq 12.9$ Mev) on Mg, Al, Ti, Fe, Co, Ni, Ni^{58}, Cu, Zn, and V targets was obtained by examining all γ radiation ($E_\gamma \geq 600$ kev) associated with the bombardments. These data were subjected to optical model analysis. Satisfactory fits were obtained except in cases involving the shell closure (N or Z = 28). The presence of a combined S and D wave size resonance for ~7.0-Mev protons on nickel was confirmed. (auth)

8148 ON THE MECHANISM OF PHOTONUCLEAR REACTIONS. A. M. Badalian and A. I. Baz (Institute of Atomic Energy, Moscow, U.S.S.R.). p.739-40 of "Proceedings of the International Conference on Nuclear Structure."

Data available on photonuclear reactions at energies below the 10- to 20-Mev region were analyzed by the statistical model and also on the assumption that the reaction proceeds mainly through relatively few one-particle levels. It was found that the statistical model is not capable of explaining or reconciling experimental data. (M.C.G.)

8149 YIELD AND ANGULAR DISTRIBUTION OF FAST PHOTONEUTRONS. R. G. Baker and K. G. McNeil (University of Toronto, Canada). p.740-3 of "Proceedings of the International Conference on Nuclear Structure."

The yields and angular distributions of the fast (direct) photoneutrons from 25 medium and heavy nuclei were measured using silicon threshold detectors. Systematic variations of both the yield (A_0) and the coefficient a_2 of $W(\Theta) = A_0(P_0 - a_2P_2)$ are interpreted in terms of the Wilkinson shell model of electric dipole photonuclear direct interactions. (auth)

8150 DIPOLE EXCITATION OF C^{12} IN THE INELASTIC SCATTERING OF 156 MEV PROTONS. Pierrette

Benoist-Gueutal (Laboratoire de Physique Nucléaire, Orsay, France). p.743-6 of "Proceedings of the International Conference on Nuclear Structure."

$\Delta J = 1$, yes, $\Delta T = 1$ excitation of C^{12} in the inelastic scattering of 156 Mev protons was calculated in the impulse approximation, showing the competition between the photonuclear giant resonance mainly excited by the Coulomb forces and another dipole collective state excited in a spin flip scattering of the proton which gives the major contribution for angles of scattering >6°. (auth)

8151 THE PHOTODISINTEGRATION OF Be^9. W. Bertozzi, P. Demos, S. Kowalski, F. Paolini, and C. Sargent (Massachusetts Institute of Tech., Cambridge). p.746 of "Proceedings of the International Conference on Nuclear Structure."

The neutron spectra which result from the photodisintegration of beryllium were measured by time-of-flight for a series of eleven bremsstrahlung energies ranging from 5 to 17 Mev. The data indicate that the total cross section is the sum of three partial cross sections, corresponding to (γ,n) processes which leave Be^8 in its ground state and in its 2.9-Mev excited state, and a (γ,α) process which leaves He^5 in its lowest state. Features of these partial cross sections are described. (auth)

8152 PHOTONUCLEAR ACTIVATION CROSS SECTIONS AT 20.5 MEV. W. del Bianco and W. Stephens (Univ. of Penna.). p.746-8 of "Proceedings of the International Conference on Nuclear Structure."

The photonuclear activation cross sections of elements whose (γ,n) reaction leads to a suitable positron activity were measured at 20.45-Mev photon energy. Carbon, F, Cr, Fe, Cu, Zn, Mo, and Sb were exposed to the γ rays from H^3 bombarded with Mev protons and the resultant positron activity detected through its annihilation radiation. (auth)

8153 THE EVAPORATION OF PROTONS FROM RAPIDLY ROTATING NUCLEI. D. Bodansky, R. K. Cole, W. G. Cross, C. R. Gruhn, and I. Halpern (Univ. of Washington, Seattle). p.749-51 of "Proceedings of the International Conference on Nuclear Structure."

A large yield of coincident protons (about 550 mb) was observed in scintillation counter studies of the $(\alpha,2p)$ reaction in Ni^{58} at 32 Mev. Cross sections and energy and angular distributions were characteristic of evaporation from a rotating compound nucleus. The distributions, which were symmetric about 90°, were much more anisotropic than estimated for rigid body rotation. (auth)

8154 LONG RANGE CORRELATIONS AND PHOTO EFFECT IN NUCLEI. W. Brenig (Massachusetts Inst. of Tech., Cambridge). p.751-3 of "Proceedings of the International Conference on Nuclear Structure."

The velocity c of the Goldhaber-Teller collective mode in the photo effect is shown to be connected with the structure factor s(k) of nuclear matter by $s(k) = k/2mc$. The structure factor was calculated in the "random phase approximation." The value obtained for c was larger than the semiclassical one (Migdal-Jensen-Steinwedel) and in better agreement with shell model configuration mixing calculations. (auth)

8155 GIANT RESONANCE REGION OF EXCITATION IN Ne^{20}. C. Broude and H. E. Gove (Chalk River, Canada). p.754-7 of "Proceedings of the International Conference on Nuclear Structure."

The 90° yield of γ rays leading to the ground and first excited state of Ne^{20} and of α particles to the ground state of O^{16} was measured using the reactions $F^{19}(p,\gamma)Ne^{20}$ and $F^{19}(p,\alpha)O^{16}$ in the proton energy range from 4 to 11 Mev. A number of broad resonances with 100-kev spacing appeared in the γ yield. In the α yield narrower resonances appeared with their envelope correlated with the γ yield to some extent. (auth)

8156 PARAMETERS OF NEUTRON RESONANCES IN U^{238} + n UP TO 1.8 KEV. F. W. K. Firk, J. E. Lynn, and M. C. Moxon (Atomic Energy Research Establishment, Harwell, Berks, England). p.757-60 of "Proceedings of the International Conference on Nuclear Structure."

Parameters of 100 resonances in U^{238} + n were determined using a general method of area analysis. A strength function $(\Gamma^o n)_{\lambda_V}/\overline{D} = (1.00 \pm 0.15) \times 10^{-4}$ was obtained. The reduced neutron widths have a Porter-Thomas distribution with $\nu = (1.02 \pm 0.12)$ degrees of freedom. A Wigner distribution of level spacings is indicated. (auth)

8157 ABSORPTION AND SCATTERING OF PHOTONS BY HOLMIUM AND ERBIUM. E. G. Fuller and E. Hayward (National Bureau of Standards, Washington, D. C.). p.760-of "Proceedings of the International Conference on Nuclear Structure."

The neutron production cross section and the differential elastic scattering cross sections at 90° are given for holmium and erbium. The former cross sections are essentially identical and show clearly the splitting of the giant resonance resulting from the large intrinsic deformations of these nuclei. Analysis of the two experiments indicates a large tensor polarizability for these nuclei. (auth)

8158 SCATTERING OF PHOTONS BY DEFORMED NUCLEI. E. G. Fuller and E. Hayward (National Bureau of Standards, Washington). p.763-6 of "Proceedings of the International Conference on Nuclear Structure."

The relation between various recently published expressions of the scattering cross section for photons by deformed nuclei is given. The existence of a sum rule is pointed out. This shows that if the scattering is measured in poor resolution so as to include the nuclear Raman scattering, all dependence of the scattering cross section on the nuclear spin is eliminated. (auth)

8159 PHOTONEUTRON DISINTEGRATION BELOW THE GIANT RESONANCE: BERYLLIUM-9 AND CARBON-13. D. T. Goldman, N. C. Francis (Knolls Atomic Power Lab., Schenectady, N. Y.), and E. Guth. p.766-9 of "Proceedings of the International Conference on Nuclear Structure."

The direct interaction photoneutron cross sections of Be^9 and C^{13} were calculated using single particle bound states and distorted continuum states. The beryllium results just above threshold agree quite well with the available experimental data. The s- and d-wave photoneutron cross sections in C^{13} were calculated using potential well parameters that describe $n\text{-}C^{12}$ scattering. The cross section is about a factor of 3 larger than experiment. (auth)

8160 THE EFFECT OF NUCLEON PAIR CORRELATIONS ON THE PROBABILITY OF ELECTROMAGNETIC TRANSITIONS. Yu. T. Grin (U.S.S.R.). p.769-71 of "Proceedings of the International Conference on Nuclear Structure."

The influence of pair interactions on electromagnetic transitions in an axially deformed nucleus was investigated. It was determined that the so called "single particle" transitions in odd nuclei are single-quasi particle transitions. The equation developed for corrections for pair correlations improved the agreement between theory and experiment. (M.C.G.)

8161 TRANSITION PROBABILITIES OF CAPTURE GAMMA RAYS IN U^{239}. D. J. Hughes, H. Palevsky. H. Bolotin, and R. Chrien (Brookhaven National Lab., Upton, N. Y.). p.771-4 of "Proceedings of the International Conference on Nuclear Structure."

The relative transition probabilities were determined for the prominent 4.06-Mev radiative transition from ten levels in U^{239} populated by s-wave neutron capture. The transition probabilities display an average deviation of 12 ± 3%, and are remarkably constant compared to an average deviation of 240% found for the reduced neutron widths of the same ten levels. The observed distribution of the γ-ray transitions corresponds to $\chi 2$ distribution with 90 ± 30 degrees of freedom. (auth)

8162 HIGH ENERGY γ RAYS FROM LEVELS EXCITED IN THE GIANT RESONANCE REGION BY INELASTIC SCATTERING OF 150 MeV PROTONS. N. Marty, H. Langevin, and X. de Bouard (Laboratoire de Physique Nucléaire, Orsay, France). p.774-6 of "Proceedings of the International Conference on Nuclear Structure."

Protons at 150 Mev excite in light nuclei a peak in the giant resonance region. Looking for high energy γ rays in coincidence with inelastically scattered protons from these peaks in C^{12} and O^{16}, an average of 1.5 γ rays was found for 10^3 such protons, indicating a 1-excitation. These γ rays did not seem to have the same energy for protons scattered at 10 and 25°. (auth)

8163 SPACING DISTRIBUTION AND LEVEL-DENSITY IN RANDOM MATRIX APPROXIMATION. M. L. Mehta (Centre d'Études Nucléaires, Saclay, France). p.776-9 of "Proceedings of the International Conference on Nuclear Structure."

The distribution function of the level-spacings of a random matrix was strictly majorized and minorized, which showed that Wigner's surmise was a good approximation. However, an exact calculation of the first derivatives of the distribution function at zero spacing showed that it was not rigorously exact. The exact level-density was also derived in collaboration with Mr. M. Gaudin. (auth)

8164 CORRELATIONS IN NUCLEON MOTIONS. Henry W. Newson (Duke Univ., Durham, N. C.). p.780-3 of "Proceedings of the International Conference on Nuclear Structure."

After correcting for the dependence on excitation and angular momentum of the compound nucleus, it is found that the s-wave resonance spacing decreases according to the relation $\exp(-0.45\ T)$ where T is the neutron excess. This effect was interpreted as a sign of the correlations in nucleon motion which are to be expected from the nature of exchange forces. (auth)

8165 SINGLE PARTICLE EFFECTS IN (n,p) SPECTRA OF MEDIUM WEIGHT NUCLEI. R. A. Peck, Jr. (Brown Univ., Providence, R.I.). p.783-6 of "Proceedings of the International Conference on Nuclear Structure."

Spectra of five (n,p) reactions on nuclei from rhodium to antimony are presented. Some common gross structure appears, showing dips at the single neutron energy gaps corresponding to magic numbers 82 and 126, and energy displacements of the spectra agree with separations of the ground state neutron configurations computed from the Nilsson model. (auth)

8166 VIBRATIONS IN SPHERICAL AND NEARLY SPHERICAL NUCLEI. P. H. Stelson. p.787-800 of "Proceedings of the International Conference on Nuclear Structure."

The properties of nuclei which exhibit rather strongly enhanced E2 transitions but lie outside the regions of spheroidal nuclei are discussed. The observed quadrupole distortions for most even-even nuclei are summarized. The predictions of the phonon model are compared with experimental data to provide a background for the evaluation of a number of modifications and alternative interpretations. Quantitative information on transition rates and experimental information on level structure in the region above the first 2+ state are summarized. (M.C.G.)

8167 ROTATION-VIBRATION INTERACTION IN NON-AXIAL EVEN ATOMIC NUCLEI. A. Davydov. p.801-13 of "Proceedings of the International Conference on Nuclear Structure."

The coupling between rotational and vibrational motions in nonaxial nuclei due to centrifugal force was investigated. It was found that the influence of these two motions on collective excitation could be separated. (M.C.G.)

8168 DOUBLE STRIPPING REACTIONS. A. A. Jaffe. p.814-23 of "Proceedings of the International Conference on Nuclear Structure."

The theoretical and experimental aspects of double stripping reactions are discussed. Angular distributions were determined for (t,p) reactions on B^{11}, C^{12}, O^{16}, and Be^9. The $O^{16}(t,p)O^{18}$ and $O^{16}(He^3,p)F^{18}$ reactions were compared. Angular distributions from (He^3,p) reactions on Be^9 and Li^6 were also measured. (M.C.G.)

8169 ELASTIC AND INELASTIC DIFFRACTION SCATTERING. J. S. Blair. p.824-37 of "Proceedings of the International Conference on Nuclear Structure."

The theory of inelastic diffraction scattering and some of its applications to inelastic scattering experiments performed with strongly absorbed α particles are discussed. A comparison was made of elastic and inelastic scattering exciting a 2+ level in Mg^{24}. The inelastic diffraction scattering model introduced by Drozdov and Inopin to treat scattering from a black ellipsoid is reviewed and generalized. The model was tested by measuring cross sections at several different energies and then calculating to see if the scaling law works. Odd parity oscillations were analyzed. The collective matrix elements in the quadrupole case were calculated and found to be close to those obtained from electromagnetic experiments. (M.C.G.)

8170 AN EXPERIMENTAL TEST OF THE STATISTICAL THEORY OF NUCLEAR REACTIONS. D. L. Allan (Harwell, England). p.838-42 of "Proceedings of the International Conference on Nuclear Structure."

A test was made of the statistical theory of Weisskopf and Ewing. The (n,p) differential cross sections were measured in the backward direction (120°) of about 30 target nuclei for 14-Mev neutrons. The (n,p) cross sections for even-even nuclei were found to be about 4 times larger than for even-odd or odd-even nuclei. Comparisons with the results of statistical theory calculations showed excellent agreement for even-odd and odd-even target nuclei. Equally good agreement was obtained for even-even nuclei provided a pairing energy parameter was introduced. (M.C.G.)

8171 FISSION PHENOMENA AND NUCLEAR STRUCTURE. I. J. J. Griffin. p.843-61 of "Proceedings of the International Conference on Nuclear Structure."

The study of nuclear structure by fission induced by resonance and fast neutrons and by other projectiles is discussed. It was postulated that for resonance fission, the mass asymmetry of the fission may depend on the spin of the resonance state. The status of some aspects of fission relevant to the unified model is reviewed. An analysis was

made of fission fragment anisotropies and angular distributions. (M.C.G.)

8172 FISSION PHENOMENA AND NUCLEAR STRUCTURE. II. G. C. Hanna. p.862-73 of "Proceedings of the International Conference on Nuclear Structure."

The late stages of fission are discussed in terms of assumptions derived from less heavily distorted nuclei. The de-excitation of primary fission fragments by isotropic evaporation of neutrons and γ emission was investigated. It was found that the position of the heavy mass peak in the mass yield curve is independent of the mass of the fissioning nucleus. Several theories of fission splitting are discussed. (M.C.G.)

8173 ON THE ENERGY OF EXCITATION OF FISSION FRAGMENTS. B. T. Geilikman. p.874-5 of "Proceedings of the International Conference on Nuclear Structure."

The energy of deformation of fission fragments was calculated using the shell model with the Nilsson Hamiltonian. Similar results were obtained by the model of the ellipsoidal rectangular well. It was found that for a qualitative evaluation of the asymmetry of fission, the calculations must be based on deformed shells and not on spherical fragments. (M.C.G.)

8174 THE KINETIC ENERGY OF FISSION FRAGMENTS FROM THE PHOTO-FISSION OF Th^{232} AND U^{238}. A. P. Komar. p.875-81 of "Proceedings of the International Conference on Nuclear Structure."

Measurements were made of the kinetic energy of fission fragments from the photofission of Th^{232} and U^{238} irradiated with bremsstrahlung at 70 Mev. The fission fragment energies were obtained by comparison with α pulses from the targets. The distribution of the number of fissions was found as a function of mass ratio for all energy values. The mass distribution of the fission fragments was also determined. (M.C.G.)

8175 THE RESONANCE ENERGY CROSS SECTION OF U^{233}. N. J. Pattenden (Oak Ridge National Lab., Tenn.), and J. A. Harvey. p.882-4 of "Proceedings of the International Conference on Nuclear Structure."

Accurate transmission measurements were made on several highly enriched metal foils of U^{233} (99.76%). The total cross section data up to 25 ev were analyzed using a multilevel resonance formula to allow for interference in fission. A good fit to the experimental data was obtained assuming a constant radiation width for the resonances, and two fission channels. (auth)

8176 FISSION FRAGMENTS FROM ORIENTED U^{233} AND U^{235}. L. D. Roberts (Oak Ridge National Lab., Tenn.), F. J. Walter, J. W. T. Dabbs, G. W. Parker, and J. O. Thomson. p.884-6 of "Proceedings of the International Conference on Nuclear Structure."

Studies of fission fragment angular distributions from thermal neutron induced fission of aligned U^{233} and U^{235} nuclei show an isotropic distribution from U^{233} and a moderate anisotropy (opposite in sign to the α particle anisotropy) from U^{235}. These results are compared with Bohr's suggestion that K = 0 should be preferred. A strong preference of this type is not indicated. (auth)

8177 ANGULAR DISTRIBUTION OF FISSION FRAGMENTS INDUCED BY LOW ENERGY NEUTRONS. V. M. Strutinski. p.887-9 of "Proceedings of the International Conference on Nuclear Structure."

The angular distribution of fission fragments induced by low-energy neutrons when the orbital moment of the neutron is comparable with the spin of the target nucleus is considered. Expressions for the angular distribution for a given spin of the compound nucleus were also obtained. It was found that the spin orbital interaction of the incident neutron and nucleus does not affect the results appreciably. (M.C.G.)

Particle Accelerators

8178 (CF-59-7-107) TIME DEPENDENCE OF THE BEAM IN THE 86-INCH CYCLOTRON. C. D. Goodman (Oak Ridge National Lab., Tenn.). July 29, 1959. 4p.

The study revealed the bunching of protons to produce a short beam burst on each cycle of the 13.4 Mc/sec accelerating voltage. In addition to the 13.4 Mc/sec structure, there was a 360 cps beam pulse modulation. Oscilloscope patterns are given which show: (1) the envelope of the r-f accelerating voltage; (2) 60 cps line voltage with time scale; (3) beam intensity; and (4) beam intensity at faster oscilloscope sweep. Apparently the beam intensity is critically dependent on the accelerating voltage, but is not a monotonic function of that voltage. (B.O.G.)

8179 (NYO-9358) A HOODED ARC ION SOURCE WITH A MAGNETIC MIRROR FEATURE. H. W. Fulbright (Rochester, N. Y. Univ.). Jan. 4, 1961. 6p. Contract AT(30-1)-875.

A feature is described which greatly improved the performance of the ion source in a variable energy cyclotron. The feature is a magnetic mirror built into the upper end of the arc hood by inserting a steel ball bearing of $\frac{1}{8}$-in. diameter. The color change of the top of the graphite hood, from bright orange to black after the insertion of the ball, was taken as evidence of a strong mirror action. The mirror feature has led to cyclotron operation improvements, such as reduction of arc currents required to produce satisfactory hydrogen ion currents, increase in filament lifetimes, arc stability, and reduction of cyclotron tank gas pressures. For deuterium operation, a current of ~0.75 amp and voltage of ~100 are usually sufficient. Raising the arc current from 1.0 to 2.0 amp produces a relatively small increase in beam current. (B.O.G.)

8180 (TID-11415) THE UNIVERSITY OF MICHIGAN 83-INCH CYCLOTRON. Quarterly Progress Report for Period October 1, 1960 to January 1, 1961. R. S. Tickle and W. C. Parkinson (Michigan. Univ., Ann Arbor. Coll. of Literature, Science, and the Arts). Jan. 1961. 10p. Contract AT(11-1)-912. (UMRI-03763-2-P). OTS.

Activities related to the spiral-ridge cyclotron are summarized. Work on the office-laboratory building is described, and design, development, and procurement of cyclotron components are discussed. It is noted that the professional-level portion of the technical staff is essentially complete. (J.R.D.)

8181 (JPRS-7385) STRUCTURAL DESIGNS OF ACCELERATORS. Translation of Stroitel'Nyye Konstruktskii Uskoriteley. A. N. Komarovskii (Komarovskiy). 1958. 185p.

Data regarding the construction planning of charged particle accelerators was assembled, systematized, and, to a certain extent, analyzed and is presented in a form designed for use in planning such installations and as a course for students studying the construction of accelerators. The topics listed are: selecting a location for accelerators; basic considerations in planning accelerator buildings; foundation base for accelerator equipment—settlement problems; foundations for main accelerator equipment; protective walls and roofing in accelerator

buildings; buried depth and protective earth cover of accelerator walls; use of blocks for biological protection at installations; floors and interiors of installations; and doors in protective walls of the installations. (21 references) (JPRS)

8182 EXPERIMENTAL INVESTIGATION OF THE CONSTRICTION OF A BUNDLE OF ELECTRONS IN A SYNCHROTRON AT 280 MEV. A. G. Ershov, F. A. Korolev, O. F. Kulikov, and B. I. Shkurskiĭ (Moscow State Univ.). Doklady Akad. Nauk S.S.S.R. 133, 554-7(1960) July 21. (In Russian)

Variations in the transverse dimensions of an electron bundle in the process of acceleration were measured by taking moving pictures of a 25-mm section of the electron orbit at a rate of 4300 frames per second. Up to 25 pictures of an electron bundle could be obtained starting at an electron energy of about 100 Mev. Measurements of the film blackening showed that the electron bundle had the shape of an ellipse with a ratio of axes which was very close to the ratio of the vertical and radial dimensions of the acceleration chamber. The width of the electron bundle at 0.3, 0.4, 0.5, and 0.6 I_{max} was measured from the intensity distribution curves, and the ratio of the width of the bundle at the instant t to the width of the bundle t = 2.76 msec (E = 86 Mev) was determined. A comparison of theoretical calculations with the experimental data shows that the radial dimensions of an actual bundle decrease faster than it should from the relation $a \sim E^{-\frac{1}{2}}$ where a is the amplitude of the synchrotron oscillations. Moreover, the center of the radial dimensions of the bundle is constricted more rapidly than the peripheral part. The results were reproducible on dropping the electrons out of an equilibrium orbit attained at 242 Mev by decreasing the amplitude of the high-frequency voltage in the accelerating section of the synchrotron in a predetermined manner. (TTT)

8183 KINEMATIC ELECTRON BUNCHING BY SINUSOIDAL TRAVELLING AND STANDING WAVES IN SHORT EXTENDED INTERACTION REGIONS. Hellmut Golde (Univ. of Washington, Seattle). J. Electronics and Control 9, 285-302(1960) Oct.

The kinematic bunching of electron beams by sinusoidal traveling and standing waves of constant amplitude in the absence of space charge is treated on a large-signal basis, using the general theory developed by Wessel-Berg. The theory predicts a maximum fundamental r-f current of 1.4 times the d-c current for synchronous interaction, which may be increased a small amount for nonsynchronous interaction. In order to check the validity of the theory, the equations of motion were integrated numerically on a high-speed electronic computer; the theory agrees well with these computations if the electric field does not exceed a certain critical value. Although the increase in fundamental r-f current for nonsynchronous operation over the synchronous value is not very great, the velocity spread within the beam is considerably reduced. A calculation is included of beam-loading effects, which are compared with theoretical values. (auth)

8184 A UNIFIED THEORY OF ELECTRON BEAM INTERACTION WITH SLOW WAVE STRUCTURES, WITH APPLICATION TO CUT-OFF CONDITIONS. Robert M. Bevensee (Stanford Univ., Calif.). J. Electronics and Control (1) 9, 401-37(1960) Dec. (In English)

An analysis is given of slow wave structures coupled to electron beams, which is based on their resonant properties rather than their traveling wave properties. Thus the analysis is particularly appropriate for narrow band slow wave structures. The fields of a general symmetrical cavity chain are expanded in a set of solenoidal and irrotational short-circuit modes, defined within electric shorting planes on the coupling surfaces. The amplitudes of the modes are evaluated in terms of the beam current and tangential electric field on the coupling surfaces. The latter field is expanded in a set of open-circuit modes which amplitudes are related back to those of the short-circuit modes with the aid of a Variational Principle. Alternately, the fields of a cavity are expanded in a set of open-circuit modes, "driven" by the beam current and by tangential magnetic field on the coupling surfaces. This latter field is expanded in a set of short-circuit modes, which amplitudes are related to the open-circuit mode amplitudes with the aid of the Variational Principle. The accuracy of the procedure is verified for a narrow pass-band by proving the relation power flow equals stored energy times group velocity. It is possible to prove the equivalence of the dispersion relations for a "cold" structure obtained from the short- and open-circuit mode expansions. Small signal transmission line equations are obtained for a longitudinally confined beam, including relativistic effects, under the action of cavity solenoidal electric field and space charge irrotational field. Analysis is applied to a study of the beam-circuit interaction when the slow space charge beam mode is nearly synchronous with the "cold" circuit near the latter's cut-off. This is the situation which often leads to oscillations in high-power structures, interfering with their operation at a lower frequency. On a small-signal basis, four waves exist, two of constant amplitude and a pair of growing and decaying waves. The cut-off oscillations, which exist in a relatively wide voltage range such that the slow beam mode is in synchronism with the "cold" circuit near the cut-off, are attributed to the presence of the growing wave of forward circuit power and negative beam power. As the voltage is lowered (in a structure of forward group velocity from zero to π phase shift), the negative power of the growing wave changes to positive power at about the condition marking the boundary of the cut-off oscillations. As the voltage is lowered further, two constant amplitude waves of negative beam power appear, enabling backward wave oscillations to exist within a narrow voltage range. This distinction between cut-off oscillations and backward wave oscillations should be made in the general class of slow wave structures. (auth)

8185 PARTICLE LOSSES AND BEAM DISTRIBUTION IN A COLLECTOR. QUANTUM EMISSION FLUCTUATIONS. S. A. Kheĭfets (Inst. of Physics, Academy of Sciences, Armenian SSR). Pribory i Tekh. Ekspt. No. 6, 14-17(1960) Nov.-Dec. (In Russian)

Functions for beam distribution and particle losses in a collector were developed, considering radiative attenuation and variability of the field along the orbit. The results indicate the losses in phased and radial betatron oscillations. (tr-auth)

8186 TIME DISTRIBUTION OF BEAMS IN A COLLECTOR. SCATTERING ON RESIDUAL GAS ATOMS. S. A. Kheifets (Inst. of Physics, Academy of Sciences, Armenian SSR). Pribory i Tekh. Ekspt. No. 6, 18-19(1960) Nov.-Dec. (In Russian)

Evaluations were made of the time distribution of a particle beam disappearing due to the elastic and inelastic scattering on residual gas atoms (multiple and single). (tr-auth)

8187 METHOD FOR DETERMINING THE EFFICIENCY OF ACCELERATING GAPS. L. M. Prokunin.

Pribory i Tekh. Ekspt. No. 6, 20-2(1960) Nov.-Dec. (In Russian)

Studies were made of a method for determining the efficiency by direct analysis of the potential magnitudes in the discrete points of the potential diagram. The order of error was evaluated, and the optimum calculations are indicated. (tr-auth)

8188 THE VACUUM SYSTEM OF A 3 BeV PROTON SYNCHROTRON. L. Seidlitz, T. Tang, D. L. Collins, and M. Szekely (Princeton Univ., N. J.). p.150-8 of "Sixth National Symposium on Vacuum Technology Transactions, October 7, 8, and 9, 1959, Philadelphia, Pennsylvania." New York, Pergamon Press Inc., 1959.

The main features of the 3-Bev proton synchrotron being constructed by Princeton University and the University of Pennsylvania are described and illustrated. The principal component of the vacuum system is the vacuum chamber in which the protons circulate during the acceleration cycle. The design of the chamber was partly determined by boundary conditions set by the experimental uses of the accelerator, by environmental factors such as high-energy nuclear radiation and rapidly varying magnetic fields and by restrictive spatial conditions, as well as by the required operating pressure of 2×10^{-6} mm Hg. The unusual features of the resultant solution are detailed. The pumping system, consisting of 24 individual units, and the complement of instrumentation are presented. The control system, which permits remote operation and indication of most of the vacuum system components, is described. The manner in which the vacuum control system interlocks with other accelerator components is discussed. (auth)

8189 ELECTROSTATIC GENERATOR. (to High Voltage Engineering Corp.). British Patent 856,025. Dec. 14, 1960.

An electrostatic generator can be designed with interleaving structures to increase the capacitance of the charge carrier and thus minimize losses. It can be adapted to operate at high voltage and high power output or at lower voltage and very high current. Drawings are included for configurations of the invention using multiple disks, chain-link belts, and interleaving drums. (D.L.C.)

8190 PARTICLE ACCELERATOR AND METHOD OF CONTROLLING THE TEMPERATURE THEREOF. R. B. Neal and W. J. Gallagher (to U. S. Atomic Energy Commission). U. S. Patent 2,956,201. Oct. 11, 1960.

A method and means for controlling the temperature of a particle accelerator and more particularly to the maintenance of a constant and uniform temperature throughout a particle accelerator is offered. The novel feature of the invention resides in the provision of two individual heating applications to the accelerator structure. The first heating application provided is substantially a duplication of the accelerator heat created from energization, this first application being employed only when the accelerator is de-energized thereby maintaining the accelerator temperature constant with regard to time whether the accelerator is energized or not. The second heating application provided is designed to add to either the first application or energization heat in a manner to create the same uniform temperature throughout all portions of the accelerator.

8191 ACCELERATOR TARGET POSITIONER AND CONTROL CIRCUIT THEREFOR. K. F. Stone, R. J. Force, W. W. Olson, and D. S. Cagle (to U. S. Atomic Energy Commission). U. S. Patent 2,964,710. Dec. 15, 1959.

An apparatus is described for inserting and retracting a target material with respect to the internal beam of a charged particle accelerator and to circuitry for controlling the timing and motion of the target placement. Two drive coils are mounted on the shaft of a target holder arm and disposed within the accelerator magnetic field with one coil at right angles to the other. Control circuitry alternately connects each coil to a current source and to a varying shorting resistance whereby the coils interchangeably produce driving and braking forces which swing the target arm within a ninety degree arc. The target is thus moved into the beam and away from it at high speeds and is brought to rest after each movement without whiplash or vibration.

Plasma Physics and Thermonuclear Processes

8192 (AERE-L-108) LECTURES ON THE HYDROMAGNETIC STABILITY OF A CYLINDRICAL PLASMA. PART 7. THE ROLE OF COMPRESSIBILITY. R. J. Tayler (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Oct. 1960. 15p.

It was shown previously that only in a magnetic field of constant pitch are stability criteria influenced by compressibility. In this case compressible perturbations which exactly follow the field lines are more unstable than similar incompressible perturbations. For all other perturbations, including those which are arbitrarily close to following the field lines, incompressible perturbations are the least stable. In addition incompressible perturbations arbitrarily close to following the field lines are less stable than compressible perturbations following the field. It is shown that the incompressible perturbations have large shear components which tend to infinity as the perturbation helix tends to coincide with the magnetic field helix. Thus in the limit they are improper perturbations and in any real system they must be limited by viscosity; on the other hand, the compressible perturbations following the field lines are finite everywhere. Even in the absence of viscosity, perturbations with extremely large shear components can be shown to have vanishingly small growth rates. (auth)

8193 (AERE-M-548) EXACT SOLUTIONS FOR THE ADIABATIC COLLAPSE AND FORCED RADIAL PULSATIONS OF A PLASMA CYLINDER CONTAINING A MAGNETIC FIELD. R. J. Tayler (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Oct. 1960. 25p.

The radial adiabatic motion of an ideally conducting plasma is governed by a complicated nonlinear partial differential equation. For particular equilibrium configurations of the plasma and particular values of the force exerted on the plasma surface, separable solutions of the differential equation can be found. For these solutions the problem is reduced to the solution of simple ordinary differential equations. Such separable solutions can be obtained for a plasma with an arbitrary density profile but, once this is prescribed, there are restrictions on the possible magnetic field and pressure profiles. Detailed results are obtained for only one density profile and the solutions are used to describe both plasma collapse and forced pulsations about an equilibrium position. The current waveforms, which provide the required force on the plasma surface, are calculated. (auth)

8194 (CEA-1580) UTILISATION DES CARACTÉRISTIQUES DE SONDES DANS DES PLASMAS EN PRES-

ENCE DE CHAMP MAGNÉTIQUE. (The Use of Probe Characteristics in Plasma in the Presence of a Magnetic Field). A. Brunet, R. Geller, and J. Leroy (France. Commissariat à l'Énergie Atomique. Centre d'Études Nucléaires, Saclay). 1960. 40p.

The principal methods of interpretation of probe characteristics in plasma in the presence of magnetic fields are summarized. The methods are presented in such a form as to be immediately applicable in a particular case. This article is therefore principally useful to experimenters. Finally, a comparison of experimental methods is offered. (T.R.H.)

8195 (CF-60-1-73) PROPOSAL FOR A THERMONUCLEAR EXPERIMENT INVOLVING INJECTION OF MOLECULAR IONS AT 600 kev, DISSOCIATION BY MULTIPLE PASSES THROUGH AN ARC, AND EXPONENTIATION UPON THE RESULTING TRAPPED ATOMIC ION POPULATION. P. R. Bell, E. S. Bettis, D. L. Coffey, W. F. Gauster, G. G. Kelley, N. H. Lazar, J. N. Luton, R. J. Mackin, C. E. Normand, E. D. Shipley, A. Simon, A. H. Snell (Oak Ridge National Lab., Tenn.). Mar. 4, 1960. 86p.

A quantitative projection of the results obtained with DCX shows that build-up beyond present plasma densities can probably be accomplished by using multiple passes of an injected molecular ionic beam through a dissociative arc instead of the single pass that is used at present. An experiment along these lines is proposed, the objective being to determine the extent to which a 300-kev H^+ plasma can be built up in density beyond the present range of 10^9–10^{10} H^+ particles per cm^3. An investigation of experimental parameters is presented, which includes a survey of the magnetic-field requirements, an estimate of the injected H_2^+ beam currents needed and a discussion of their practical realization, a discussion of the vacuum pumping situation, and a treatment of demands on the ion source and beam injection systems to yield a beam of acceptable quality. It is concluded that the experiment is within technical reach, and the construction of a powerful and versatile apparatus is proposed. As a minimum, such an apparatus would permit a study of the successive factors that may emerge to limit the accumulation of a 300-kev steady-state hydrogen plasma to densities of thermonuclear interest. (auth)

8196 (LAMS-2477) STABILITY OF A DIFFUSE HOLLOW-CORE TOROIDAL PINCH. B. R. Suydam (Los Alamos Scientific Lab., N. Mex.). Oct. 15, 1960. 17p. Contract W-7405-eng-36.

The reduction of the energy integral for a general toroidal pinch is discussed. After some manipulation, a form for the δW integral is found which, it is hoped, may prove useful in further investigations. One simple result that is found is an extension to the toroidal hollow-core pinch of the well-known cylinder result, that it is sufficient for stability, in the latter case, that $J_z B_\theta \leq 0$ everywhere. (auth)

8197 (NP-9747) NONLINEAR PLASMA OSCILLATIONS. H. W. Wyld, Jr. (Space Technology Labs., Inc. Physical Research Lab., Los Angeles). Sept. 12, 1960. 52p. (STL/TR-60-0000-GR303)

A study is made of nonlinear plasma oscillations in one dimension in a low, but finite, temperature two-component plasma. Nonlinearities arising from thermal effects and nonlinearities due to finite ion mass are considered separately. Thermal nonlinearities are shown to give rise to a nonlinear dispersion relation for a monochromatic wave and to spectral decay, i.e., the migration of energy in wave number space. Spectral decay arising from nonlinearities due to finite ion mass is discussed. A statistical equation for nonlinear plasma oscillations, or theory of turbulence of plasma oscillations, is briefly considered. It is shown that in a two-stream plasma a growing wave generates via the nonlinear terms, an effective uniform electric field that opposes the drift causing the growing wave. The significance of these effects for the problem of collective resistivity is discussed. (auth)

8198 (NP-9767) THE PRODUCTION OF HIGH TEMPERATURE GAS BY MAGNETIC ACCELERATION. Research Report 27. G. S. Janes and R. M. Patrick (Avco Mfg. Corp. Avco Research Lab., Everett, Mass.). Mar. 1958. 16p. Contract AF49(638)-61.

Experimental devices for investigating the dynamic interactions of high-temperature gases with magnetic fields are described. One such device can be used to create a moving slug of hot gases in which magnetic lines tend to be excluded from the center by electrical gas conductivity. Cold gas ahead of this moving slug is heated by collisions that occur during the acceleration produced by a magnetic field. In another experimental device, a voltage of about 15 kv is applied between a pair of coaxial cylinders. During breakdown, the initial axial magnetic field due to the bias coil causes the electrons to move primarily in the circumferential direction until such times as they undergo collisions. A helical field pattern is produced, and the gas is polarized in such a way that the radial currents for certain conditions are distributed in the axial direction up to the shock front. Applications and limitations of these devices are discussed. (J.R.D.)

8199 (ORNL-3040) EXACT RELATIVISTIC FOKKER-PLANCK COEFFICIENTS FOR A PLASMA. Albert Simon (Oak Ridge National Lab., Tenn.). Jan. 25, 1961. 47p. Contract W-7405-eng-26.

A plasma is considered which, in zero order, is static, spatially uniform, and infinite in extent and with no external electric or magnetic fields. Exact relativistic Fokker-Planck coefficients are obtained by a solution of the first order coupled integral equations for the particle and oscillator pair correlation functions. The solution is by a generalization of the method of Lenard and Balescu. The resulting coefficients have contributions from both coulomb interactions and from interactions via transverse electromagnetic fields. (auth)

8200 (TID-3070(Rev.1)) CONTROLLED THERMONUCLEAR REACTIONS. A Selective Bibliography. Sidney F. Lanier, Raymond L. Scott, and Thomas W. Scott, comps. (Office of Technical Information Extension, AEC). Jan. 1961. 185p.

A total of 1395 annotated references to research reports and journal articles is cited, covering work on fusion reactions, plasma physics, magnetohydrodynamics, plasma containment, pinched discharges, magnetic mirrors, plasma diagnostics, and other topics related to controlled thermonuclear research. Author, subject, and report number indexes are included. (auth)

8201 (TID-11395) STUDIES OF PLASMA OSCILLATIONS. Final Report [for] September 1—November 30, 1960. (Stanford Univ., Calif. Microwave Lab.). Dec. 1960. 16p. Contract AT(04-3)-326, Project Agreement No. 1. (ML-774). OTS.

Plasma oscillations were studied with the objective of determining and explaining the mechanisms for the growth of instabilities and oscillations in a gaseous discharge, with particular emphasis on the action of sheaths and wave in-

teractions with particles in the discharge. The effect of parameters such as geometric shapes and boundaries, magnetic field, and pressure are also taken into account. (W.L.H.)

8202 (TID-11405) THE USE OF ATOMIC BEAMS AS A PROBE FOR STUDYING LOW DENSITY PLASMAS. Quarterly Report for October 1, 1960 to January 1, 1961. (New York Univ., New York). 20p. Contract AT-(30-1)-2397. OTS.

The completed neutral beam system was placed in operation. The system consists of an oven, velocity selector magnet, scattering chamber, velocity analyzer magnet, and detector. The operation of the magnetic velocity selector was investigated for potassium atoms, and the attenuation of a potassium atom beam by neon gas was measured as a function of beam velocity at two gas temperatures. Preliminary data were obtained on the operation of the positive ion source to be used in the production of the fast neutral beam. (W.L.H.)

8203 (TID-11509) THE USE OF ATOMIC BEAMS AS A PROBE FOR STUDYING LOW DENSITY PLASMAS. Quarterly Report for October 1, 1960 to January 1, 1961. (New York Univ., New York). 13p. Contract AT-(30-1)-2397.

Operation of the complete neutral-beam system is reported. The system consists of an oven, velocity selector magnet, scattering chamber, velocity analyzer magnet, and detector. The operation of the magnetic velocity selector was investigated for potassium atoms, and the attenuation of a potassium atom beam by neon gas was measured as a function of beam velocity at two gas temperatures. Preliminary data on operation of the positive ion source to be used in production of a fast neutral beam were obtained. (For preceding period see TID-6753.) (J.R.D.)

8204 (UCRL-9344) SOME CALCULATIONS ON THE TRIAX PINCH DEVICE. Shalom Fisher (California. Univ., Berkeley. Lawrence Radiation Lab.). Aug. 9, 1960. 35p. Contract W-7405-eng-48.

The hydromagnetic equations of motion for the Triax pinch are linearized by a perturbation expansion about equilibrium. The perturbed equations are then decomposed by the method of normal modes. A numerical calculation is made of the oscillation frequency for two specific modes (k = 0, m = 0; and k = 0, m = 1). The m = 0, k = 0 mode is also analyzed by using a hydromagnetic energy principle. (auth)

8205 THE DEPENDENCE OF THE PLASMA CONDUCTIVITY ON FREQUENCY AND COLLISION TIME. O. Theimer and L. S. Taylor (New Mexico State Univ., University Park). Ann. Phys. (N. Y.) 11, 377-92(1960) Nov.

The drift velocity $\bar{q}(T)$ (T = time) of electrons in a plasma exposed to an external radiation field E(T) is calculated by a method that takes the finite duration of encounters between charged particles explicitly into account. Orbits of electrons passing through the nearest neighbor zone of an ion and exposed to the field of that ion and to the radiation field are computed as a function of the collision parameter, p, the gas kinetic velocity, v; and the time of closest approach between electron and ion, $T_0 \cdot \bar{q}_0(T)$, is obtained as an average over the stochastic variables p, v, T_0, and is found to satisfy the equation $m[d\bar{q}(T)/dT] = -\epsilon(T) - m\nu_c(\omega)\bar{q}(T)$, where m and $-\epsilon$ are the electron mass and charge, respectively. The coefficient of dynamical friction $m\nu_c(\omega)$ is a function of the radiation frequency ν_0 of the form $m\nu_c(\omega) = m\nu_c[1 + (2\pi^{2/3} i\nu_0\, d/\nu)(1 - 3.35/\log d/\pi^{1/3} p_0) - 0.835(2\pi^{2/3}\nu_0\, d/v)^2 + \ldots]$, where ν_c is the conventional collision frequency, P_m the average distance between neighboring ions, and p_0 the collision parameter corresponding to 90° deflection. (auth)

8206 A CONTRIBUTION TO THE PROBLEM OF REGISTERING PLASMA ENERGY LOSSES. Yu. G. Prokhorov. Doklady Akad. Nauk S.S.S.R. 134, 1058-60 (1960) Oct. 11. (In Russian)

A radiative transducer for recording energy release at container walls was applied in evaluating containment of plasma in a toroidal chamber by a strong magnetic field. The minimum energy recorded was $\sim 2 \times 10^{-3}$ joule/cm^2. The gas flow curves are plotted and analyzed. (R.V.J.)

8207 SPACE CHARGE INSTABILITIES IN SYNTHESIZED PLASMAS. A. L. Eichenbaum and K. G. Hernqvist. (RCA Labs., Princeton, N. J.). J. Appl. Phys. 32, 16-21 (1961) Jan.

A theoretical and experimental investigation of instability phenomena in synthesized plasmas is carried out. In the theoretical analysis the space charge and potential distributions are obtained for an idealized one-dimensional model. The model consists of two face-to-face electrodes each emitting ions and electrons in any ratio and with a Maxwellian velocity distribution. The calculations show that no stable zero-field solution is possible; instead, distributions with either a potential maximum or minimum in the center are obtained. For a range of values of the ratio β of injected ion to electron space-charge density near unity ($0.81 \leq \beta < 1.235$), double-valued solutions to the problem are obtained. The actual solution into which the system settles depends on whether this range of β values is approached from above or below. Transitions from one such state to the other can occur at the limits of this β range. In the experimental investigation of a synthesized plasma, these instabilities, or state-to-state transitions, were found to be in good agreement with the theory. Oscillations triggered by state-to-state transitions were observed with a frequency corresponding to the ion transit time through the interelectrode space. These oscillations are not described by the steady-state analysis. (auth)

8208 MICROWAVE MEASUREMENTS OF THE RADIATION TEMPERATURE OF PLASMAS. G. Bekefi and Sanborn C. Brown (Massachusetts Inst. of Tech., Cambridge). J. Appl. Phys. 32, 25-30(1961) Jan.

Radiation-temperature measurements of positive columns of glow discharges in helium, neon, and hydrogen were compared with calculations and with Langmuir probe measurements of the electron temperature. The microwave-noise radiation was detected at a frequency of 3000 Mc. The plasma studied was illuminated by a blackbody source of known variable temperature. The blackbody temperature was adjusted until the received noise power became independent of the presence of the unknown plasma. At this point, the temperature of the two radiators is the same, irrespective of the magnitude of the plasma absorptivity. (auth)

8209 REFLECTION AND TRANSMISSION OF ELECTROMAGNETIC WAVES AT ELECTRON DENSITY GRADIENTS. Frank A. Albini and Robert G. Jahn (California Inst. of Tech., Pasadena). J. Appl. Phys. 32, 75-82(1961) Jan.

Solutions are obtained for the propagation of plane electromagnetic waves parallel to a gradient of free electron density, in the form of complex Airy functions. Reflection and transmission coefficients are derived for normal inci-

dence on a linear "ramp" of electron density connecting a uniform dielectric gas with a uniform ionized gas, as functions of ramp length and propagation exponent of the latter. Machine evaluations of typical cases of physical interest are displayed and discussed. Similar study is made of two-stage ramps of variable proportions, intended as second approximations to smooth profile transition zones. In each case, the reflection and transmission coefficients are found to depend strongly on ramp width over a range of several tenths of a wavelength, then to oscillate mildly toward the asymptotic values predicted from a WKB-type approximation. The results are less sensitive to the detailed shape of the electron density profile. Propagation through a finite slab of ionized gas bounded on each side by such linear transition zones is formulated and evaluated for typical cases. Asymptotic approximations for the linear ramp problem are found to be inadequate to cover the entire range of interest. The neglect of variation in collision frequency through the transition is discussed and justified for a broad class of equilibrium profiles. (auth)

8210 STABILITY OF A PLASMA SHEET IN TIME PERIODIC MAGNETIC FIELDS. L. Solymar (Standard Telecommunications Ltd., Harlow, Essex, Eng.). J. Electronics and Control (1) 9, 391-6(1960) Nov. (In English)

The behavior of a thin sheet of electrons in a time-varying square wave magnetic field is investigated. It is shown that the growth of an initial disturbance that takes place in the first half of a period is entirely annulled in the second half, both the displacements and the velocities returning to their initial values. It is concluded that the break-up of annular beams in a uniform magnetic field, which has been observed, should be strongly inhibited in a periodic field. (auth)

8211 NOTE ON THE POSITIVE COLUMN IN MIXTURES OF IODINE AND ARGON. G. A. Woolsey, R. Seymour, K. G. Emeleus, and J. R. M. Coulter (Queen's Univ., Belfast). J. Electronics and Control (1), 9, 467-71(1960) Dec.

Three types of positive column were obtained in low-pressure discharges through a mixture of an inert and an electronegative gas. For small currents striations form which are bowed axially in the opposite sense to that usually found. With increase in current these develop axial protuberances which blend to give either a stationary or a mobile constricted column. The effects described so far are time averages. (auth)

8212 EXPLORATION OF OSCILLATING BEAM-PLASMA FIELDS WITH A TRANSVERSE ELECTRON BEAM. A. Garscadden and K. G. Emeleus (Queen's Univ., Belfast). J. Electronics and Control (1) 9, 473-6(1960) Dec. (In English)

Experiments are described in which a low-pressure oscillating electron-beam and plasma system is explored by a second electron beam transverse to the first. The energy spread (scattering) found in the main system when high frequency, probably electrostatic oscillations are occurring, is found to be present in the exploring beam only when the latter is in or has traversed a section of the main discharge where oscillations and scattering can be detected. With the discharge described, the magnitude of the scattering in the transverse beam was about 8 v when the scattering in the main beam was about 14 v. The results appear to be compatible with considerable randomization and possible breakup of the main beam by the oscillations. (auth)

8213 THE PROBLEM OF RADIATION FROM PLASMAS. K. G. Emeleus and A. Garscadden (Queen's Univ., Belfast, Northern Ireland). Naturwissenschaften 47, 491(1960) Nov. (1). (In English)

In experiments with a large number of tubes, basically of the Langmuir and Tonks and of the Merrill and Webb hot cathode types, in which electron oscillations occur, it was found that the tube considered as a whole almost always radiates with about the plasma electron frequency. It is believed that at least a large part of the radiation probably did not come directly from the plasma but from the electrodes and their leads inside the tube. The problems, therefore, of introducing exploring electrodes or loops which do not receive high-frequency currents directly from the plasmas or beams can be considered. Probes outside the main electron beam can be exposed to parasitic oscillating beams. The need for caution in the interpretation of experiments in which radiation from the plasmas was observed is emphasized. (J.S.R.)

8214 ELECTRON ENERGY DISTRIBUTIONS IN PLASMAS. II. HYDROGEN. R. L. F. Boyd and N. D. Twiddy (Univ. Coll., London). Proc. Roy. Soc. (London) A259, 145-58(1960) Dec. 6.

Studies were made of low-pressure discharges in which an electronic method was used for the Druyvesteyn analysis of electron energy distribution. The method reported by Boyd & Twiddy was applied to the study of the mechanism of striation structure in hydrogen discharges, in the pressure range 0.01 to 0.1 mm Hg and the current range 0.016 to 0.800 A. The basic relations governing the current flow, ionization rate, and energy flux were established and verified. These relations and this mechanism are not specific to hydrogen. The measurements revealed insufficient electrons with energy capable of producing H^+ and H_2^+ directly, though it is possible that electrons having passed through two striation heads may make an important contribution. In view of earlier reports of the predominance of H_3^+ in such discharges it is tentatively suggested that the process $H' + H_2 \rightarrow H_3^+ + e$ may be important. (auth)

8215 INTERACTION OF SLOW PLASMA WAVES WITH AN ELECTRON FLOW. V. Ya. Kislov and E. V. Bogdanov. Radiotekh. i Elektron. 5, 1974-85(1960) Dec. (In Russian)

Experimental and theoretical investigations were carried out on various possible mechanisms of nonrelativistic electron interactions with plasma in a magnetic field. The analysis revealed two types of waves: surface and volume. The maximum volume-wave amplitude field is found near the axis of the system and is not observed in an ordinary slowing down structure. Both types of waves have regions of normal and abnormal dispersion. (R.V.J.)

8216 BOUNDARY CONDITION FOR CONCENTRATION OF CHARGE CARRIERS IN PLASMA PLACED IN A MAGNETIC FIELD. I. A. Vasil'eva. Radiotekh. i Elektron. 5, 2015-25(1960) Dec. (In Russian)

The method of free paths was used in an analysis of de-Groot type boundary condition in a magnetic field. The boundary conditions are applied in determining the distribution of charged particles along the radius of a cylindrical tube with and without considerations for volume recombination. The calculated curves are correlated with experimental data. (tr-auth)

8217 ON THE MECHANISM OF ORIGIN OF THE CATHODE SPOT AT NEGATIVE-CHARGED ELECTRODES IN GAS-DISCHARGE PLASMA. Ya. Ya. Udris. Radiotekh. i Elektron. 5, 2026-32(1960) Dec. (In Russian)

Cathode spot appearance on a negative electrode in a plasma, resulting from mercury or metal particle drops, was studied by oscillographic and rapid exposure methods. The process was analyzed and the mechanism of cathode spot appearance resulting from a mercury drop is classified in relation to the potential range and local pressure increase produced by the drop. (tr-auth)

8218 TENSOR OF PLASMA ELECTRIC PERMEABILITY WITH A BEAM. M. A. Gintsburg. Radiotekh. i Elektron. 5, 2060-2(1960) Dec. (In Russian)

The components of plasma electric permeability were calculated on the basis of the V. D. Shafranov formula. It is postulated that plasma is described by the Maxwellian distribution function, that charged particle beams (ions and electrons) pass through plasma, and that the outer magnetic field H_0 is homogeneous, $H_0 || O_z$, $U || H_0$. (R.V.J.)

8219 ON A PARTICULAR SOLUTION OF EQUATIONS OF MAGNETIC GAS DYNAMICS. O. A. Berezin. Vestnik Leningrad. Univ. 15, No. 1, Ser. Mat. Mekh. i Astron. No. 1, 107-10(1960). (In Russian)

The solution of magnetic gas dynamics equations depending on one arbitrary function is given. The solution has been conjugated with the shock wave propagating in motionless gas in the medium with some initial density, $\rho_1(\chi_2)$; pressure, $P_1(\chi_2)$; and strength of magnetic field, $h_1 = h_1^0 - P_1(\chi_2)$. The form of the functions $\rho_1(\chi_2)$ and $P_1(\chi_2)$ and the shock-wave-motion law are determined from the conditions of the dynamical compatibility. (auth)

8220 THE THEORY OF PLASMA IN THE PRESENCE OF MAGNETIC FIELDS. J. Friedrich (Osram-Studiengesellschaft, Berlin). Z. Physik 160, 494-503(1960). (In German)

Based on the Boltzmann equation, a complete theory of stationary cylindrical plasma is obtained considering the presence of the self-magnetic field as well as an additional longitudinal magnetic field. The effect of electron-electron interaction is thoroughly included by expansions in terms of Sonine polynomials. The formulas of the current density and heat-flow components of nth order approximation explicitly determined here are derived in terms of mean free paths which depend on the directions of transport as well as of the producing gradient. In the same manner the corresponding components for a Lorentz plasma are given. (auth)

8221 MAGNETOHYDRODYNAMICS. (Office of Technical Services, Washington, D. C.). Aug. 1960. 8p. (SB-426). $0.10(OTS).

A bibliography of 122 reports listed in the two OTS monthly abstract journals: U. S. Government Research Reports and Technical Translations. This bibliography includes reports added to the OTS collection during the period 1950 to September 1960. (OTS)

8222 EVALUATION OF LARGE DIFFUSION PUMPS AND TRAPS FOR THE ULTRA-HIGH VACUUM SYSTEM OF THE MODEL C-STELLARATOR. W. G. Henderson, J. T. Mark, and C. S. Geiger (Radio Corp. of America, Lancaster, Penna.). p.170-5 of "Sixth National Symposium on Vacuum Technology; Transactions, October 7, 8, and 9, 1959, Philadelphia, Pennsylvania." New York, Pergamon Press Inc., 1959.

An investigation was conducted to determine the design parameters of large ultra-high vacuum pumping systems for the C-Stellarator installation at Princeton University. Many techniques have been developed and much design data have been obtained which will aid in the final design of ultra-high vacuum equipment. A description is given of the pumps, traps, and pressure gages which make up the vacuum system. The procedures necessary to maintain an ultra-high vacuum in a continuously pumped system are outlined. (B.O.G.)

8223 ULTRA-HIGH VACUUM SYSTEM DEVELOPMENTS FOR THE MODEL C-STELLARATOR. J. T. Mark and Karl Dreyer (Radio Corp. of America, Lancaster, Penna.). p.176-80 of "Sixth National Symposium on Vacuum Technology; Transactions."

A description is given of an ultra-high vacuum system being built for the C-Stellarator, a fusion-research test facility. Design specifications call for (1) a base pressure of 2×10^{-10} mm Hg; (2) a pumping system capable of exhausting gases at pressures of 10 μ or less without detrimental effect to the base vacuum or system cleanliness; (3) the vacuum system to be built in two phases; (4) construction with 305-type stainless-steel and demountable corner-type gold-seal flanges; and (5) the system to contain a suitable "bakeable" valve to permit isolation of the Stellarator tube from the pumping system. Descriptions are given of the pumping system and the methods used in the assembly and leak testing of the assembled components. (B.O.G.)

8224 CERAMIC, SAPPHIRE AND GLASS SEALS FOR THE MODEL C-STELLARATOR. J. A. Zollman, E. I. Martin, and J. A. Powell (Radio Corp. of America, Lancaster, Penna.). p.278-82 of "Sixth National Symposium on Vacuum Technology; Transactions."

A description is given of the ceramic, glass, and sapphire seals developed for use in the C-Stellarator. The seals were developed to withstand an ultimate pressure of 2×10^{-10} mm Hg; to remain absolutely vacuum-tight during successive bakes at 450°C; and to be satisfactorily isolated to permit welding into the high-expansion type-305 stainless-steel vessel. The glass windows are conventional seals of 7056 glass to Kovar, while the ceramic-to-metal and sapphire-to-metal seals are made by the radial-compression seal technique. Expressions are given for finding the radial forces and the maximum bending stresses in the seal. The radial-compression seal has proven reliable to date in the construction of parts for the C-Stellarator vessel, as well as for electron tube production. One such seal has operated 1200 hr at 450°C; and is still vacuum-tight. One interesting sidelight is that a seal which leaks at some elevated temperature will reseat at some lower temperature and reseal. (B.O.G.)

8225 PROBLEMS OF MAGNETIC PROPULSION OF PLASMA. Ralph W. Waniek (Giannini Plasmadyne Corp., Santa Ana, Calif.). p.131-7 of "Xth International Astronautical Congress, London, 1959." Vienna, Springer-Verlag, 1960. (In English)

In the case where a plasma structure can be made to have ideal or nearly ideal diamagnetic properties, a magnetic field will act on the gaseous ionized boundary like a piston and will impart net momentum to the configuration. Theoretical problems and experimental results obtained during the course of a study aimed at accelerating ionized gases by means of strong transient magnetic fields are discussed. Recently developed strong magnetic field techniques are discussed in view of their possible application to high-field plasma thrusters. Special air-core magnet configurations are shown, and their characteristics as intermittent plasma propulsers are outlined. (auth)

8226 A PULSED PLASMA ACCELERATOR EMPLOYING ELECTRODES. S. Georgiev, R. Feinberg, and G. S. Janes (Avco-Everett Research Lab., Everett, Mass.).

p.183-201 of "Ballistic Missile and Space Technology. Vol. II." New York, Academic Press, 1960.

The possible use of plasma accelerated by electric and magnetic fields for space vehicle propulsion is briefly discussed, and the major sources of losses in plasma accelerators are outlined: frozen flow losses in expansion nozzle, plasma heat losses to accelerator walls, and losses at electrode surfaces (arc voltage drops). A magnetohydrodynamic (MHD) shock tube, in which an electric discharge is induced in a gas in an annulus, was built with no axial magnetic field and operated at specific impulses of 1000 to 7000 sec on a single pulse basis, using argon. Several experiments were performed with this MHD tube. The shock velocity was measured as a function of initial argon pressure and magnetic drive field and found to agree well with theory. The light intensity (bremsstrahlung) was measured as a function of the shock velocity for 50 μ Hg argon pressure and found to increase with velocity but to be far closer to the "frozen" argon ionization curve, for which the assumption is that argon cannot be ionized more than twice. A plot of light intensity vs. initial argon pressure at constant shock velocity confirms that argon ionization is largely frozen after the second ionization potential is achieved. The back emf of the plasma was found to be very large compared with the electrode voltage drops (~20 v), but it disagrees with theory at high shock velocities; the discrepancy may be due to incorrect current flow geometry. To evaluate the energy losses to the shock tube walls, the temperature rise of the walls was measured after an experimental run. Temperature rises of 0, 0.5, and 0.15 to 0.20°C were measured in the regions upstream, slightly downstream, and further downstream, respectively, from the point where the discharge was initiated, which is as expected. The total energy transferred to the walls was calculated and found to be 40 to 50% of the energy delivered to the experiment. (D.L.C.)

8227 THERMONUCLEAR REACTOR. Fritz Schleilein. British Patent 857,137. Dec. 29, 1960.

A thermonuclear reactor is designed comprising a toroidal chamber with electrodes on opposed wall portions and means of producing a magnetic field in the chamber to stabilize the plasma in the pinch state. Grids may also be installed between the electrodes and the plasma to prevent electrons from interfering with the thermonuclear reaction. Drawings illustrating the possible variants of the reactor are presented. (D.L.C.)

8228 IMPROVEMENTS IN OR RELATING TO THERMONUCLEAR REACTORS. Roger Hancox (to United Kingdom Atomic Energy Authority). British Patent 857,433. Dec. 29, 1960.

A thermonuclear reactor in which a high-temperature plasma is established in a torus with two insulating gaps and a liner system as described in Patent Specification No. 830,252 is modified so that the liner surface exposed to the plasma is coated with beryllia. This coating prevents arc spots (unipolar arcs) from forming on the liner and evaporating some of the liner metal with consequent plasma contamination. Beryllia is advantageous as a coating material because of its partial transparency to bremsstrahlung from the plasma. (D.L.C.)

8229 IMPROVEMENTS IN APPARATUS FOR CREATING BY INDUCTION AN ELECTRIC DISCHARGE IN A GAS AT LOW PRESSURE. (to Commissariat à l'Énergie Atomique). British Patent 857,686. Jan. 4, 1961.

An apparatus for inducing an electric discharge in a gas at low pressure to form a stable, unsoiled plasma is designed comprising (1) a toroidal tube whose outside surface is completely coated with a sheet of conducting material except for insulated gaps, (2) inductor windings wrapped around the tube with the turn plane parallel to the center line of the chamber and connected to a high-frequency a-c source, and (3) stabilizing windings wrapped around the gaps with the turn plane perpendicular to the center line and connected to a d-c source. (D.L.C.)

8230 STABILIZED PINCH ELECTRIC DISCHARGE APPARATUS. (to United States Atomic Energy Commission). British Patent 857,883. Jan. 4, 1961.

A pinch machine for producing a stabilized linear pinch discharge is designed comprising a metal cylinder with a central coaxial conductor rod disposed within and defining an annular discharge chamber; the cylinder and rod are insulated from the chamber so that discharge to the chamber walls is prevented. Two end caps are attached to the ends of this assembly and serve as electrodes; tubes are installed in one end cap for evacuating the chamber and introducing therein reactant gases. In operation, a pulse of electric power is passed to the electrodes which induces a high-intensity arc discharge, forming a hollow cylindrical plasma. The tendency of the plasma to collapse radially inward is modified by providing a return current path for the discharge current through the central rod and the cylinder. (D.L.C.)

8231 IMPROVEMENTS IN OR RELATING TO THERMONUCLEAR REACTORS. Roy John Bickerton and John David Jukes (to United Kingdom Atomic Energy Authority). British Patent 859,447. Jan. 25, 1961.

A thermonuclear reactor is designed with modulated discharge current so that electric energy may be extracted continuously from the discharge while the discharge stability is maintained. The reactor consists of a transformer, a vessel for fuel gas, and means for energizing the transformer to set up a pinched ring discharge in the gas, and the current modulation is carried out in such a way that the discharge gas is cycled in a closed thermodynamic cycle. Several circuits for effecting the current modulation are shown together with the corresponding waveforms for the discharge voltage and current. (D.L.C.)

8232 HOLLOW CARBON ARC DISCHARGE. J. S. Luce (to U. S. Atomic Energy Commission). U. S. Patent 2,956,195. Oct. 11, 1960.

A device is described for producing an energetic, direct current, hollow, carbon-arc discharge in an evacuated container and within a strong magnetic field. Such discharges are particularly useful not only in dissociation and ionization of high energy molecular ion beams, but also in acting as a shield or barrier against the instreaming of low-energy neutral particles into a plasma formed within the hollow discharge when it is used as a dissociating mechanism for forming the plasma. There is maintained a predetermined ratio of gas particles to carbon particles released from the arc electrodes during operation of the discharge. The carbon particles absorb some of the gas particles and are pumped along and by the discharge out of the device, with the result that smaller diffusion pumps are required than would otherwise be necessary to dispose of the excess gas.

8233 CO-AXIAL DISCHARGES. J. S. Luce and L. P. Smith (to U. S. Atomic Energy Commission). U. S. Patent 2,961,558. Nov. 22, 1960.

A method and apparatus are given for producing coaxial arc discharges in an evacuated enclosure and within a

strong, confining magnetic field. The arcs are maintained at a high potential difference. Electrons will diffuse to the more positive arc from the negative arc, and positive ions will diffuse from the more positive arc to the negative arc. Coaxial arc discharges have the advantage that ions which return to strike the positive arc discharge will lose no energy since they do not strike a solid wall or electrode. These discharges are useful in confining an ionized plasma between the discharges, and have the advantage of preventing impurities from the walls of the enclosure from entering the plasma area because of the arc barrier set up by the cylindrical outer arc.

8234 METHODS AND MEANS FOR OBTAINING HYDROMAGNETICALLY ACCELERATED PLASMA JET. John Marshall, Jr. (to U. S. Atomic Energy Commission). U. S. Patent 2,961,559. Nov. 22, 1960.

A hydromagnetic plasma accelerator is described comprising in combination a center electrode, an outer electrode coaxial with the center electrode and defining an annular vacuum chamber therebetween, insulating closure means between the electrodes at one end, means for introducing an ionizable gas into the annular vacuum chamber near one end thereof, and means including a power supply for applying a voltage between the electrodes at the end having the closure means, the open ends of the electrodes being adapted for connection to a vacuumed utilization chamber.

8235 GASEOUS DISCHARGE DEVICE. J. D. Gow (to U. S. Atomic Energy Commission). U. S. Patent 2,967,943. Jan. 10, 1961.

An extremely compact two-terminal gaseous discharge device is described that is capable of producing neutrons in copious quantities, relatively high energy ions, intense x rays, and the like. Principal novelty resides in the provision of a crossed electric-magnetic field region in the discharge envelope that traps electrons and accelerates them to very high energies to provide an intense ionizing medium adjacent the anode of the device for ionizing gas therein with extremely high efficiency. In addition, the crossed-field trapping region holds the electrons close to the anode whereby the acceleration of ions to the cathode is not materially effected by the electron sheath and the ions assume substantially the full energy of the anode-cathode potential drop. (auth)

8236 METHOD OF PRODUCING ENERGETIC PLASMA FOR NEUTRON PRODUCTION. P. R. Bell, A. Simon, and R. J. Mackin, Jr. (to U. S. Atomic Energy Commission). U. S. Patent 2,969,308. Jan. 24, 1961.

A method is given for producing an energetic plasma for neutron production. An energetic plasma is produced in a small magnetically confined subvolume of the device by providing a selected current of energetic molecular ions at least greater than that required for producing a current of atomic ions sufficient to achieve "burnout" of neutral particles in the subvolume. The atomic ions are provided by dissociation of the molecular ions by an energetic arc discharge within the subvolume. After burnout, the arc discharge is terminated, the magnetic fields increased, and cold fuel feed is substituted for the molecular ions. After the subvolume is filled with an energetic plasma, the size of the magnetically confined subvolume is gradually increased until the entire device is filled with an energetic neutron producing plasma. The reactions which take place in the device to produce neutrons will generate a certain amount of heat energy which may be converted by the use of a conventional heat cycle to produce electrical energy.

Shielding

8237 (NNSD-R-7-4/1) FLUX FROM HOMOGENEOUS CYCLINDERS CONTAINING UNIFORM SOURCE DISTRIBUTIONS. Y. P. Mangum, Jr. (Newport News Shipbuilding and Dry Dock Co., Va.). Nov. 15, 1956. 41p.

Data are presented tabularly on flux from a cylindrical source attenuated by plane laminated shields. Plots of $\pi \nu \phi$ as a function of the shield thickness in units of the absorption mean free paths are presented where ϕ = flux ($cm^{-2}-sec^{-1}$), and ν = absorption coefficient of cylinder (cm^{-1}). (See also WAPD-RM-213.) (J.R.D.)

8238 (ORNL-1471) SHIELD OPTIMIZATION. E. P. Blizard (Oak Ridge National Lab., Tenn.). Mar. 17, 1953. Decl. Sept. 2, 1960. 20p. Contract W-7405-eng-26. OTS.

A theoretical treatment of shield optimization in nuclear-powered aircraft is given. An expression is developed for the ratio of neutron to γ dose rates in an optimized spherically symmetric shield. The general method for shield optimization in which a finite number of parameters is adequate is outlined, and the optimization of a box-shaped shield as an example of this method is considered. (L.M.T.)

8239 (WADC-TR-59-443) FANTASIA AND TRIPROD—SHIELDING CODES FOR THE 1103A UNIVAC. [Period covered]: April 1958 to April 1959. Herbert Steinberg, Jerome Heitner, and Raphael Aronson (TRG. Inc., Syosset, N. Y.). Sept. 1959. 109p. Project No. 7360. Contract AF33(616)-5187.

Codes were developed for the 1103A Univac (FANTASIA). FANTASIA computes neutron transmission through laminated slab shields and slowing down density within the shields by Monte Carlo methods. TRIPROD is a slowing down code suitable for shielding problems. It is based on the General Electric reactor code VALPROD. Both theory and application of FANTASIA and TRIPROD are discussed. Operating instructions are included. (auth)

8240 SETTABLE NEUTRON RADIATION SHIELDING MATERIAL. I. R. Axelrad (to U. S. Atomic Energy Commission). U. S. Patent 2,961,415. Nov. 22, 1960.

A settable, viscous, putty-like shielding composition is described. It consists of an intimate admixture of a major proportion of a compound having a ratio of hydrogen atoms to all other atoms therein within the range of from 0.5 : 1 to 2 : 1, from 0.5 to 10% by weight of boron, and a fluid resinous carrier. This composition when cured is adapted to attenuate fast moving neutrons and capture slow moving neutrons.

Theoretical Physics

8241 (JINR-D-618) ON GAUGE TRANSFORMATIONS OF GREEN FUNCTIONS. V. I. Ogievetskii (Ogievetski) and I. V. Polubarinov (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1960. 14p.

The gage transformation laws of many-particle green functions are obtained. In general, Ward's identities follow from these laws. (auth)

8242 QUANTUM LIMITATIONS OF MACH'S PRINCIPLE. Asher Peres (Israel Inst. of Tech., Haifa). Bull. Research Council Israel. Sect. F, 9, 71-4(1960) Nov. (In English)

It is shown that the quantum uncertainty of the angular momentum and angular position of a rotator causes an uncertainty in its gravitational field, which grows to infinite values at very large distances from the rotator. It is

thereby inferred that a finite distribution of matter can determine which frames are inertial only within a finite distance. Cosmological consequences of this fact are discussed. (auth)

8243 APPROXIMATE SOLUTIONS OF THE BETHE-SALPETER EQUATION. S. H. Vosko (Carnegie Inst. of Tech., Pittsburgh). J. Math. Phys. 1, 505-15(1960) Nov.-Dec.

A modified representation of the Bethe-Salpeter wave function for scalar particles interacting via a massless scalar field is presented and related to Salpeter's approximate wave function. A procedure for obtaining approximate solutions of the Bethe-Salpeter equation for arbitrary interactions is introduced. The method is based on a variational principle and is capable of high accuracy when used with the trial functions developed. The choice of trial function is suggested by the important features of the exact solutions for the special case described above. The method is applied to a finite range potential which corresponds to the lowest-order approximation to a simple field theory. The results of the calculation suggest that the effect of retardation is large when an interaction is transmitted by a field with mass. (auth)

8244 "FRONT" DESCRIPTION IN RELATIVISTIC QUANTUM MECHANICS. R. Acharya and E. C. G. Sudarshan (Univ. of Rochester, N. Y.). J. Math. Phys. 1, 532-6 (1960) Nov.-Dec.

The problem of introducing a Cartesian position operator canonically conjugate to the momentum operator into relativistic one-particle theories is investigated independent of any particular relativistic wave equation. The known result that such a description is possible for particles with non-vanishing mass is rederived. The general problem of introduction of canonical variables into relativistic theories is formulated and solved. The configurational indexes so obtained correspond to directed plane wavefronts rather than point particles. (auth)

8245 OBSERVATION OF THE HYPERFINE STRUCTURE SPLITTING OF MUONIUM BY USE OF A STATIC MAGNETIC FIELD. R. Prepost (Columbia Univ., New York), V. W. Hughes, and K. Ziock. Phys. Rev. Letters 6, 19-21(1961) Jan. 1.

A muon beam was passed into a target of 55 atm argon with a magnetic field in the beam direction, and the decay positrons were counted as a function of the magnetic field, which was varied from 100 to 5800 gauss. The ratio of the positron counting rate for a dummy target to that for the gas target is plotted vs. the magnetic field and compared with theoretical curves for various values for the hyperfine structure separation $\Delta\nu$ of the $1\,^2S_{1/2}$ state of the muonium formed. The results indicate that all the muons form muonium and that $\Delta\nu$ lies between 2250 and 9000 Mc. (D.L.C.)

8246 ON THE DECOMPOSITION OF THE FEYNMAN PROPAGATOR. Alladi Ramakrishnan (Universität, Bern), T. K. Radha, and R. Thunga. Proc. Indian Acad. Sci., Sec. A 52, 228-39(1960) Nov. (In English)

The Feynman propagator, in momentum representation, is a four-dimensional transform over space and time variables. If the space and time integrations are performed separately, the propagator can be decomposed into two parts, one corresponding to a positive and the other to a negative energy intermediate state. By the use of this decomposed propagator, the relative contributions of the positive and negative energy intermediate states to the matrix element can be estimated. For example in Compton scattering it leads to the apparently paradoxical result that in the "nonrelativistic approximation" it is only the negative energy intermediate state that contributes to the matrix element. (auth)

8247 ON CERTAIN IDENTITIES CONNECTED WITH THE EINSTEIN TENSOR. J. L. Synge (Dublin Inst. for Advanced Studies, Ireland). Proc. Roy. Irish Acad. A. 61, 29-36(1960) Dec.

A set of identities connected with the Einstein tensor G_{ij} is derived and applied to weak gravitational fields to deduce that $L_{ij}(\gamma) = 0$ implies $Q_{ij,j}(\gamma) = 0$. (D.L.C.)

8248 TESTING OF QUANTUM ELECTRODYNAMICS BY COMPTON SCATTERING AND PAIR ANNIHILATION. H. Salecker (Univ., Freiburg i. Br.). Z. Physik 160, 385-405(1960) (In German)

In view of the present experimental efforts, Compton scattering and pair annihilation in flight are analyzed as purely electrodynamic processes to test quantum electrodynamics at small distances. After a short discussion of the introduction of the form factors, the possibility of a (partial) cancellation between electrodynamic and nucleon structure effects are considered. The possibility of a partial cancellation of the nonlocal effects in Compton scattering and wide-angle bremsstrahlung also exists because of the opposite action of space-like and time-like form-factor arguments. The Compton and the two photon pair annihilation cross sections are calculated with form factors, and the result is illustrated with several numerical diagrams. Two photon pair annihilation turns out to be especially favorable for a first test of quantum electrodynamics because there is no cancellation of possible nonlocal effects, and the necessary very high energy can be circumvented by a colliding beam experiment. With a 10% experimental error, the planned colliding beam experiment at Stanford with 500 Mev could test the electron propagation function down to 0.6×10^{-14} cm. After that, Compton scattering can be used to investigate the electron propagation function for time-like arguments. (auth)

REACTOR TECHNOLOGY

General and Miscellaneous

8249 (AAEC/E-55) THE CRITICAL SIZE OF A BARE SPHERICAL REACTOR WITH ANISOTROPIC DIFFUSION. J. J. Thompson (Australia. Atomic Energy Commission Research Establishment, Lucas Heights, New South Wales). Nov. 1960. 9p.

Using oblate spheroidal co-ordinates, the critical equation for a bare sphere with unequal axial and radial diffusion coefficients is derived. A two-group model is used, with the degree of anisotropy the same in both groups. (auth)

8250 (BAW-1213) SPECTRAL SHIFT CONTROL REACTOR; BASIC PHYSICS PROGRAM. QUARTERLY TECHNICAL REPORT, JULY–SEPTEMBER 1960. 59p. Contract AT(30-1)-2602.

Activities in a program to obtain basic physics data on lattices of slightly enriched fuel in a moderator consisting of D_2O-H_2O mixtures of different concentrations in the range of parameters of interest to the Spectral Shift Control Reactor concept are presented. The major effort during this period was the planning and design of the experiments and the preparation of hazards evaluations. The planning, design, and procurement were essentially com-

pleted for the critical experiments, exponential experiments, and neutron age measurements. Initial plans for the cladding experiment were modified as a result of preliminary calculations. No work was performed on the hot exponential experiments, and progress on the measurement of plutonium temperature effects was delayed until information could be obtained on the cost and availability of special plutonium-spiked test elements. Theoretical analyses were performed to obtain parametric data needed to support the design of the experiments and the hazards evaluations. Work was also begun on developing methods to analyze the experimental data starting with an evaluation of the various approximations used to describe neutron slowing down and diffusion in mixtures of hydrogen and deuterium and the development of a digital computer code with a B_1 or P_1 spatial distribution option and the Greuling-Goertzel slowing down approximation for routine calculations. (auth)

8251 (BM-IC-7965) POSSIBILITIES OF USING NUCLEAR ENERGY FOR GASIFYING COAL. James P. McGee and Sidney Katell (Bureau of Mines, Washington, D. C.). 1960. 13p.

Preliminary calculations show an economic advantage in using nuclear energy to supply the endothermic heat required for gasifying coal. It should be noted that the various assumptions used in preparing these calculations must undergo further evaluation through additional engineering design and research. The proposed system for gasification is the indirect process cycle with helium heated in a nuclear reactor and passed through an exchanger type gasifier for the reaction of coal and steam to form CO and H_2. To test the feasibility of this system, a high-temperature helium loop was constructed to test components such as heat exchangers, recycle compressors, and valves. Heat is generated by graphite spheres heated in an induction field. (auth)

8252 (CEA-1398) RIFIFI: METHODE DE CALCUL ANALYTIQUE DE LA CONDITION CRITIQUE ET DES FLUX D'UNE PILE A REGIONS VARIEES EN THEORIE A DEUX GROUPES ET A UNE DIMENSION PROGRAMMEE POUR LE CALCULATEUR ELECTRONIQUE MERCURY (FERRANTI). (RIFIFI: Analytical Method of Calculation of the Multizone, Two-groups, One Dimensional, Critical Conditions and Fluxes of a Reactor; Program for the Ferranti-Mercury Digital Computer). A. Amouyal, P. Bacher, B. Lago, F. L. Mengin, and E. Parker (France. Commissariat à l'Énergie Atomique. Centre d'Études Nucléaires, Saclay). 1960. 29p.

The analytical calculation method given was programmed for the Ferranti-Mercury digital computer. It solves two-group one-dimensional diffusion equations and equations with continuity of fluxes and currents in spherical, cylindrical, and linear geometries. In the two latter cases, an extrapolated height and radius respectively can be taken into account. The critical condition can be achieved by a linear variation of one or several k_∞ of a boundary between two media, or of the extrapolated height or radius. The number of media is limited to fourteen. The program can also calculate fluxes, flux adjoints, and various integrals. (auth)

8253 (CF-58-7-4) ANALYTICAL STUDY OF SOME ASPECTS OF VORTEX TUBES FOR GAS-PHASE FISSION HEATING. J. L. Kerrebrock and P. G. Lafyatis (Oak Ridge National Lab., Tenn.). July 21, 1958. Decl. Sept. 2, 1960. 84p.

Several problems connected with vortex cavity reactors were studied analytically. They include, the generation of high-strength vortices by utilization of bleed through a porous tube wall to stabilize the shear layer on the wall; the nuclear criticality problem; the suitability of various compounds of plutonium as gaseous fissionable materials; and the problem of retaining the fission fragments within the vortex tube. It is concluded that the shear layer on the vortex tube wall can be stabilized if a mass flow greater than or equal to the vortex through flow is bled through the porous wall, and that the tangential Mach numbers which can be obtained are then slightly more than one-half the inviscid values. Beryllium oxide or graphite-moderated reactors of reasonable size and weight can attain criticality if the product of the hydrogen pressure in the vortex core and the maximum value of the ratio of fissionable gas density to hydrogen density in the tube is greater than about 100 atm. The reactor weights are then in the order of 50,000 lb or less. Of the several compounds of plutonium considered as gaseous fuel carriers, plutonium trifluoride and plutonium tribromide appear to be the most promising. It is probable that they can be held in gaseous form in hydrogen, under the desired concentrations. The rate of loss of fission fragments from the vortex tube can be reduced to a small fraction of the rate of their generation by making the vortex tubes about twice the minimum size that is allowable for satisfactory retention of the fissionable material. (auth)

8254 (CF-58-12-158) SAFETY AND OPERABILITY REVIEW OF EXPERIMENTS TO BE OPERATED IN NUCLEAR REACTORS AT ORNL. C. D. Cagle (Oak Ridge National Lab., Tenn.). Dec. 1958. 61p.

The operation of the tests and experiments conducted in the ORR, the LITR, and the ORNL Graphite Reactor is discussed. In order to minimize the possibility of any hazardous conditions developing into an incident involving the safety of personnel, the reactor, and other equipment, any experiment design and installation should be checked or reviewed to ensure that all conceivable dangers are recognized and that appropriate safeguards have been incorporated into the design. (W.D.M.)

8255 (CF-59-12-94) REACTIVITY CONTROL BY ADDITION OF NEUTRON POISONS TO SLURRY REACTORS. R. L. Pearson, B. E. Prince, D. W. Jeffrey, and W. L. Brassert (Oak Ridge National Lab., Tenn.). Dec. 22, 1959. 16p.

Calculations show that slurry fueled reactors may be maintained subcritical at arbitrary concentrations and at reactor temperatures above a specified minimum by addition of a soluble neutron poison to the slurry. Experiments with a boric acid poisoned aqueous urania-thoria slurry at simulated reactor concentrations and temperatures indicate that adequate removal of the boron can be obtained. If a slurry type homogeneous reactor fueled with 1080°C-fired oxides of thorium and uranium is poisoned with boric acid prior to start-up and the boron in the supernatant liquor subsequently removed, the neutron loss by adsorbed boron can be small enough to permit breeding to take place during operation. However, oxide fired at 650°C has too high a surface area and too low a desorption rate to permit the required boron removal. (auth)

8256 (CF-60-12-111) HOMOGENEOUS MOLTEN SALT REACTORS. C. W. Nestor, Jr. (Oak Ridge National Lab., Tenn.). Dec. 13, 1960. 9p. OTS.

Multigroup one-dimensional calculations were done recently to obtain estimates of critical masses, power-density distributions, and fissioning spectra for some homogeneous molten salt reactors having outer reflectors and central islands, which are to be placed inside the cur-

ently proposed MSRE vessel. For a 5-in.-thick outer reflector and a 1-ft-diameter island, both of which are beryllium, the calculated critical mass is 108 kg; 40% of the fissions occur at thermal, and the maximum power density is 3.9 times the core mean power density occurs at the island-salt interface. If the reflector thickness is increased to 10 in., the critical mass is reduced to 34 kg; 67% of the fissions occur at thermal, and the peak power density of twice the core mean again occurs at the core island-salt interface. (auth)

3257 (CRRL-990) A LOOP TEST USING AMMONIA FOR pH CONTROL. G. M. Allison (Atomic Energy of Canada Ltd., Chalk River, Ont.). Nov. 1960. 18p. (AECL-1158).

The carbon steel X-4 loop in the NRX reactor was operated for four months with the coolant containing ammonium hydroxide to provide a pH (25°C) of 9.5. The average crud concentration in the loop water over this period was a factor of 12 higher than the normal average for this loop when operated at pH 10.5 with KOH. When returned to operation with the water at high pH (10.5) with KOH after the ammonia test it was 25 days before the crud concentration approached the normal level for the X-4 loop. The use of ammonium hydroxide did not appear to be detrimental to the fuel from the standpoint of crud deposition. Any film observed on the fuel elements was "sooty" in nature and very easily wiped off; the maximum thickness found was 0.001 in. Some build-up of crud was observed at the wire wrap and spacing fins. The ammonium hydroxide did not appear to be decomposed by irradiation. (auth)

3258 (GEAP-3288) THE FAST EFFECT IN A BERYLLIUM MODERATED REACTOR. P. E. Novak (General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.). Dec. 7, 1959. 19p. (R59APE39).

The effect of the (n,2n) and (n,α) reactions on the neutron economy of a beryllium-moderated reactor was investigated. It is pointed out that the available experimental data are not internally consistent and that a fast effect of between 1.03 and 1.19 can be obtained depending upon the interpretation of the experimental work. The analysis was therefore performed separately on the basis of several choices of interpretation: (a) the improvements in the neutron economy due to fast neutron reactions in beryllium; (b) the deleterious effect due to the build-up of absorbing substances which result from the (n,α) reaction; (c) the relative effectiveness of beryllium oxide as compared with a metallic beryllium moderator for improving neutron economy; (d) the effect of mixing a fertile material (thorium) with the beryllium; and (e) the effect of neutron leakage for a definite reactor configuration. (auth)

3259 (HW-65724(Rev.)) PRTR MECHANICAL SEAL PUMP OPERATING EXPERIENCE [FOR] SEPTEMBER 1959—AUGUST 1960. P. A. Scott (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Sept. 16, 1960. 66p. Contract AT(45-1)-1350.

The experience gained from operation of the spare PRTR primary process pump and of a small pump with prototype mechanical seals and shaft assembly is reviewed. The spare reactor pump was in operation 5500 hr, and the small pump was in operation 7500 hr, both at temperature and pressure conditions prototypical of the PRTR. The last 1584 continuous hours operation of the PRTR pump was achieved after closer bearing tolerances and component fits were provided and the running vibration was reduced to less than 1 mil. The operation of the small pump for a period of 2172 hr using the prototype of a new type self-adjusting seal assembly for the reactor pumps is also reported. (auth)

8260 (KAPL-2000-12) REACTOR TECHNOLOGY REPORT NO. 15—PHYSICS. (Knolls Atomic Power Lab., Schenectady, N. Y.). Dec. 1960. 195p. Contract W-31-109-Eng-52. OTS.

Cross Sections. The KAPL program for cross-section calculations is described. The photodisintegration of beryllium and carbon was studied with the direct interaction model. Relations were developed for (n,p) reactions and inelastic scattering. Experiments and related analyses are reported for measurement of a variety of nuclear species. The Hf^{174} activation cross section was obtained from a specially enriched sample of HfO_2. Natural Hf and Dy and Dy^{164} were examined by chopper techniques for the energy dependence of their absorption cross sections. Pile absorption cross sections for Mo^{95}, Nd^{143}, Nd^{145}, and Sm^{147} were deduced from isotropic conversion of enriched samples in a pressurized water reactor. A redetermination of the resonance integral for cobalt was conducted with a thin sample to avoid self-shielding problems. Group Constants. A special data tape of nuclear cross sections was prepared. The tape contains the best basic information currently available for a variety of strong parasitic absorbers, fuels, structural materials, etc. Definitive experiments and calculations are reported on the determination of the diffusion length of thermal neutrons in water. A very rapid and accurate scheme for digital computation of average thermal cross sections in core life studies was developed. Lattice Effects. The computer program SWAKRAUM IV is described: the mathematical and physical models employed and the several options available for calculation of thermal neutron distributions in both space and energy are included. Results are reported from PPA studies of spatial variations of thermal and epithermal neutron flux in the neighborhood of moderating and absorbing inhomogeneities. A theoretical investigation of several experiments is reported in which epithermal distributions play a decisive role. A diffusion theory routine was developed for determining γ heating in reactors. Statistical methods were applied to the calculation of self-shielding of dispersions of absorbing particles. Experimental and calculated data are given relating to PMA measurements with discrete, highly self-shielded absorbers and less complicated poison distributions. Reactor Kinetics. For the investigation of core instabilities, it is necessary to know the transfer function relating reactivity and neutron flux in the system. Perturbation theory results were developed for this function as part of the analysis required to described complicated, time-dependent reactor behavior induced by nonuniform variation of material properties. The technique of determining reactor subcriticality with pulsed-neutron measurements was automated. A physico-mathematical model was developed to study probabilities associated with occurrence of certain hazardous reactor conditions. Studies are reported on the determination of neutron generation to be expected from such phenomena as spontaneous fission of fuel, (α,n) reactions, cosmic rays, and fission-product decay. Secular Transients. Techniques for obtaining accurate cross sections were improved and generalized for the production of nuclear data to be used with arbitrary energy-group widths in depletion studies. An N^{13} positron activity in the coolant of a reactor was shown to be due to the $O^{16}(p,\alpha)N^{13}$ reaction. Reactor Physics Computations and Statistics. The TRAM program, for three-dimensional Monte Carlo calculation of low-

energy neutron transport, was modified for increased flexibility. One- and two-dimensional diffusion calculations of criticality, neutron fluxes, fuel and poison depletion, etc., are supplied by various components of the KARE system. Brief descriptions are given of a wide variety of calculations that are possible with KARE. A technique for generalized flux synthesis to permit increasingly accurate three-dimensional diffusion calculations is embodied in the CLAG program. Statistical problems that have arisen in connection with mathematical studies, sampling techniques, or design optimization are discussed. (W.L.H.)

8261 (KAPL-M-JA-10(Rev.1)) EQUATIONS FOR THE FICS ROUTINE OF THE KARE SYSTEM. J. A. Archibald, Jr. and G. L. Johns (Knolls Atomic Power Lab., Schenectady, N. Y.). Aug. 12, 1960. Revised Sept. 16, 1960. 45p. Contract W-31-109-Eng-52.

The FICS routine provides a second method of calculating cross sections for the KARE system. The specifications for FICS are the result of fitting cross sections to MUFT for energies greater than 0.625 ev, and using a two-mode variational procedure for obtaining average thermal cross sections and diffusion theory parameters for energies below 0.625 ev. The FICS package contains three schemes: a four-group scheme, a three-group scheme, and a two-group scheme. (W.L.H.)

8262 (KAPL-M-JRS-12) LONG-LIVED PHOTONEUTRONS FROM FISSION PRODUCTS. J. R. Stehn (Knolls Atomic Power Lab., Schenectady, N. Y.). Aug. 24, 1960. 11p. Contract W-31-109-Eng-52.

Estimates are presented of the strength of photoneutron sources in water-cooled reactors after continuous operation at various times after shutdown. The photoneutron source strength is proportional to the power level during operation and to the deuterium content of the water. The source strength also depends upon the geometry of the core. The computation is based upon two types of information: the known γ-emitting properties of longer-lived fission products and the measured decay of neutron flux in the NRX heavy-water reactor for the first 24 hr after shutdown following sustained operation. The fission products are listed which have decay energies exceeding the deuterium photoneutron threshold and which have half lives exceeding 1 hr. (W.L.H.)

8263 (NAA-SR-Memo-3545) SOME FIRST INTEGRALS OF THE FUCHS' EQUATION FOR SHORT DELAY TIMES. J. H. Bick (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Feb. 26, 1959. 5p.

The Fuchs' equation is a semi-empirical equation which may be used to fit reactor power excursions. An approximation to the equation was integrated for values of n = 0.5, 1.0, 1.5, and 2.0. (W.D.M.)

8264 (NAA-SR-Memo-5492) USE OF THE AIM-6 CODE FOR CRITICAL MASS CALCULATIONS FOR THE ORGANIC CRITICAL FACILITY. R. A. Blaine (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). July 13, 1960. 6p. OTS.

The AIM-6 code solves the diffusion theory approximation to the one-dimensional Boltzmann equation in multigroup form. Up to 18 groups are allowed with both elastic and inelastic scattering to as many as 5 lower groups. The code is an extension of AIM-5 and includes several additional options plus a built-in microscopic library with the option of changing cross sections as desired for each case. The major advantage of this code over the few group codes now in use is that hydrogen scattering receives a better treatment. (W.L.H.)

8265 (NAA-SR-Memo-5501) DC ELECTROMAGNETIC PUMP STUDY FOR THERMIONIC CONVERSION REACTORS. W. J. Fraser (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). July 15, 1960. 10p. OTS.

The design of a d-c conduction electromagnetic pump for pumping sodium at 1300°F at a rate of 175 gpm with a developed pressure of 15 psi is reported. The maximum conduction current available was 1000 amp. Computations show that a pump meeting the requirements weighs 552 lb and has an efficiency of 19%. A voltage of 6.1 volts is required at the pump. Owing to the limitation of conduction current available, it is necessary to use ten pumping sections in series. (W.L.H.)

8266 (NAA-SR-Memo-5550) A NOTE ON THE SHAPE OF THE POWER TRANSIENT FOLLOWING A STEP INPUT OF REACTIVITY. E. R. Cohen (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). [nd]. 7p. OTS.

A simple analytic solution is used for first-order estimates of the magnitude of a fast transient following a step input of reactivity. These estimates, although only approximations, are adequate for initial evaluations of the severity and character of a transient. (W.L.H.)

8267 (NAA-SR-Memo-5658) FUEL ELEMENTS FOR ORGANIC MODERATED REACTORS. G. D. Calkins (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Oct. 31, 1960. 29p. OTS.

Both uranium-molybdenum alloys and UO_2 types of fuel element are promising for application in organic moderated reactors. In the case of alloy elements, aluminum-clad metallurgically bonded plates and cylinders were developed. Uranium-3.5% molybdenum alloys with ternary additions of aluminum and silicon are being used, but increasing emphasis is placed on the higher molybdenum content alloys in order to achieve higher burn-ups. Pin type oxide elements were developed in which UO_2 pellets are contained in APM (SAP) tubes for more advanced operating conditions. Extensive development and proof testing programs are underway to establish the operating limits and reliability of these fuel elements. (auth)

8268 (NAA-SR-Memo-5798) INVESTIGATION OF SODIUM LEAK PLUGGING. M. L. Peelgren and J. S. McDonald (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Oct. 20, 1960. 16p.

A program is reported to investigate a method of stopping sodium leaks at 1200°F by reacting the leaking material with a gas such as carbon dioxide or oxygen. Such a plugging mechanism would be useful in preventing shutdowns due to sodium leaks such as those in the shell of a calandria core. Results indicate little likelihood of success for this mechanism above 600°F. (J.R.D.)

8269 (ORNL-2660) A PRELIMINARY EXPERIMENTAL STUDY OF VORTEX TUBES FOR GAS-PHASE FISSION HEATING. J. L. Kerrebrock and J. J. Keyes, Jr. (Oak Ridge National Lab., Tenn.). Feb. 20, 1959. Decl. Aug. 15, 1960. 54p. Contract W-7405-eng-26.

An experimental study of a simple jet-driven vortex tube indicated that the viscous retardation of the vortex motion is so severe as to prevent the formation of vortices of sufficie strength for vortex-cavity reactor applications. The large viscous effects are most likely due to the existence of turbu lent flow in the tube; hence a second experimental study, aimed at production of laminar vortices, was initiated. Eve though the viscous effects in the vortices are very strong, the variation of tangential velocity with radius is near that

for an inviscid vortex, with the velocity being proportional to the radius to a power which varies between −0.4 and −0.8. A simple model representing the influence of the outflow through the central exit nozzle on the vortex core structure is proposed. Satisfactory agreement with the measured pressure distributions near the vortex center was found. Although the tangential Mach numbers generated in the present apparatus are too low to permit separation of gases under the conditions required in vortex-cavity reactors, preliminary separations of helium from both bromine and a heavy fluorocarbon (C_8F_{16}) were obtained. The heavy gas concentration peaks were very near the center of the vortex tube at radial positions that are in reasonably good agreement with predictions. (auth)

8270 (RFP-201) NUCLEAR SAFETY EXPERIMENTS ON PLUTONIUM AND ENRICHED URANIUM HYDROGEN MODERATED ASSEMBLIES CONTAINING BORON. C. L. Schuske, G. H. Bidinger, and D. F. Smith (Dow Chemical Co. Rocky Flats Plant, Denver). July 7, 1960. Decl. Aug. 25, 1960. 14p. Contract AT(29-1)-1106. OTS.

Neutron multiplication measurements were made on cylindrical assemblies containing layers of plutonium metal disks, Plexiglas disks, and boron carbide impregnated Epolene-n disks. In addition to the above nuclear safety measurements, curves were drawn for a 42-in.-diameter stainless-steel tank containing an aqueous solution of $UO_2(NO_3)_2$ and poisoned with Pyrex Raschig rings. Attempts were made to calculate sphere, infinite cylinder and slab shapes from the experimental finite cylindrical assemblies. (auth)

8271 (TID-6505) SUMMARIES OF FUELS AND MATERIALS DEVELOPMENT PROGRAMS. (Division of Reactor Development, AEC). Aug. 1960. 108p.

The objectives are summarized of the individual research projects supported by the Fuels and Materials Development Branch, Nuclear Technology, Division of Reactor Development. It includes the research conducted at the Commission's laboratories and at industrial, university, and other laboratories. Programs in effect as of about January 1960 are listed. (W.L.H.)

8272 (TID-11316) LITERATURE SEARCH. Letter Report No. 2. E. V. Gallagher (Illinois Inst. of Tech., Chicago. Armour Research Foundation). Dec. 22, 1960. 17p. Project No. 4226. Contract AT(11-1)-938. OTS.

Results are presented of a literature search dealing with vapor suppression and other similar methods of reactor containment. (W.L.H.)

8273 (WAPD-TM-232) KATE-1 — A PROGRAM FOR CALCULATING WIGNER-WILKINS AND MAXWELLIAN AVERAGED THERMAL CONSTANTS ON THE PHILCO-2000. Harvey J. Amster and James B. Callaghan (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). Oct. 1960. 61p. Contract AT-11-1-GEN-14.

The KATE program for the Philco-2000 determines the spectrum of thermal neutrons according to the Wigner-Wilkins theory and averages various quantities important to reactor design over the spectrum. The blackness coefficients, "mixed number density" constants, diffusion constants, and macroscopic cross sections to be averaged are calculated directly. The present cross-section library is tabulated. (auth)

8274 (CEA-tr-R-1065) BOUCLE DE CIRCULATION D'UN RÉACTEUR NUCLÉAIRE COMME SOURCE DE RAYONNEMENTS. (Circulation Loop of a Reactor as a Radiation Source). Yu. S. Riabukhin and A. Kh. Breger (Breguer). Translated into French from Atomnaya Energ. 7, 129-37(1959). 22p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 13, as abstract No. 20646.

8275 NUCLEAR PIPING SYSTEM AND REACTOR CONTAINMENT DESIGN CONSIDERATIONS. Heating, Piping Air Conditioning 32, No. 11, 155-68(1960) Nov.

A report is given of some things that must be considered in designing the pressure piping systems for nuclear plants and the secondary containment shell which houses the reactor. Since the type of reactor affects the piping design considerations, various reactor concepts being developed are discussed. Factors to be considered in piping design include the application of the existing codes to nuclear piping, the effects of radiation on piping materials, corrosion problems, and accessibility for maintenance in design. (auth)

8276 PRESSURE OSCILLATIONS IN A WATER-COOLED NUCLEAR REACTOR INDUCED BY WATER-HAMMER WAVES. P. Lieberman and E. A. Brown (Ill. Inst. of Tech., Chicago). J. Basic Eng. 82, 901-11(1960) Dec.

Shutdown of the Babcock & Wilcox reactor water-coolant pumps causes check valves to close which induces the generation of water hammers in the system. The magnitude, frequency, and duration of possible pressure oscillations in the pipeline and the discharge of the pressure oscillations into the attached plenum chamber were evaluated. Although the plenum chamber contains a great number of suspended rods, it was possible to establish the upper bound for the pressure loading across the internal structure of the plenum chamber at various stations for determination of design criteria. (auth)

8277 ON THE KINETICS OF BOILING WATER REACTORS. A. Kirchenmayer (Technische Hochschule, Stuttgart, Ger.). J. Nuclear Energy, Pt. A. Reactor Sci. 12, 155-61(1960).

Under certain assumptions the transfer functions necessary for a theoretical consideration of the stability of the boiling-water reactor can be derived. As these functions are fairly complicated, approximations are desired. An approximation is given in which the influence of the spatial dependence of power is considered. The results are discussed in relation to experimental experience with EBWR. (auth)

8278 CALCULATIONS OF THE CRITICALITY CONDITION OF A BOILING WATER REACTOR. A. Müller (Wissenschaftlich-Technische Büro für Reaktorbau, Berlin-Pankow). Kernenergie 3, 951-8(1960) Oct.-Nov. (In German)

Criticality calculations for a boiling water reactor are given. It is shown in the case of strong evaporation, and considering the extrapolation length, the steam advance rate, and a subcooling of the moderator involved in the active zone at the boiling point that a continuous analytical solution of the simple one-group equations using certain assumptions and hypotheses is possible. The most important assumption is that the moderator density depends only on the height in the core, and not on the radius which is approximately attainable by a suitably chosen rate profile of the in-flowing moderator. With the additional assumption of a constant ration of steam-to-water rate, it is more exactly attainable. (T.R.H.)

8279 CALCULATION OF CONTROL DEVICES ACCORDING TO A MODIFIED ONE-GROUP THEORY.

B. Köhler (Wissenschaftlich-Technische Büro für Reaktorbau, Berlin-Pankow). Kernenergie 3, 959-62(1960) Oct.-Nov. (In German)

The effectiveness of control devices, which absorb thermal neutrons and slow down fast neutrons to some extent, can be calculated within the framework of one-group theory if one uses appropriate boundary conditions at the surface of the control device. These boundary conditions can be deduced for smooth cylindrically and spherically symmetrical control devices with the hypothesis: $K-1 \ll \frac{1}{2} + \frac{1}{4}\,(L^2/\tau + \tau/L^2)$, if the distances of the control devices from the edge of the reactor or from each other is greater than $\sqrt{L^2\tau/L^2 + \tau}$. (tr-auth)

8280 CALCULATION OF RESONANCE ABSORPTION IN URANIUM-CONTAINING FUEL ELEMENTS. G. Lehmann and B. Kozik (Technische Hochschule, Dresden). Kernenergie 3, 963-72(1960) Oct.-Nov. (In German)

Corrections are offered for the theories of Gurevich-Pomeranchuk and Wigner which make both theories equivalent in experimental exactness for practical calculations. For completions and corrections of these theories, the measurements of Hellstrand were mainly used. While it is possible with these corrections to obtain agreement with experiment within reasonable limits, the conclusions drawn from these results with respect to spatial distribution of resonance absorption in the fuel block can only be satisfied by the theory of Gurevich-Pomeranchuk. (T.R.H.)

8281 CONTAINMENT VESSELS FOR BELGIAN REACTORS BR II AND BR III, PART III. G. Herzet, P. Laval, and G. Martelée. Nuclear Energy 526-9(1960) Nov.

A discussion of the erection of the BR II and BR III containment vessels is presented in three parts: the work undertaken at the factory, site work, and controls and pressure tests. The work at the factory entailed the working-up of the materials, and the erection and welding of the main components. The site work consisted of erection and welding of the containment vessels for the reactors. The vessels were pressure tested at 17 and 57 psi for BR II and BR III, respectively, for air-tightness of welds, to make sure of the ability of the vessels to resist an internal pressure reasonably higher (20 to 25%) than the calculated pressures, to permit the perfecting of the delicate measurements of leakage loading, and to proceed to tensometric measures for determining the absence of dangerous stresses. The only leaks registered were localized in places where radiographic control was impossible and ultrasonic testing difficult to interpret. They were situated at single-bevel butt welds, mostly temporary ones. (B.O.G.)

8282 LUBRICATION REQUIREMENTS OF NUCLEAR POWERED SURFACE VESSELS. DESIGN CONSIDERATIONS. E. H. Okrent (Esso Research and Engineering Co.). Nuclear Energy 562-7; 71(1960) Dec.

The effect of nuclear-surface-vessel design on the functional requirements of lubricants is considered. The critical design features of potential nuclear-surface-propulsion systems were reviewed to determine the physical requirements imposed on the lubricant by the total environment, radiation being only one of the many factors considered. This review indicates that the lubrication problems of nuclear-propelled ships are similar to those of their conventional fossil-fueled counterparts. Radiation stress, the main new environmental feature, is a consideration only in those components which are associated with the nuclear heat source (control rods, etc.), and then it is generally not a controlling consideration. The lubricants for the propulsion gear and its auxiliary systems present no new lubrication problems. However, leakage and primary-coolant-contamination requirements often take precedence in the selection of the lubricant or lubrication system. (auth)

8283 FUEL HANDLING AT BRADWELL. Nuclear Eng. 5, 563-4(1960) Dec.

A charge-discharge machine was developed for the Bradwell CO_2-cooled reactor which has storage capacity for three channels of fresh fuel (24 elements), three channels of irradiated fuel, two fuel standpipe plug assemblies, and a control standpipe plug as well as associated handling apparatus; it can handle absorbers, graphite and steel specimens, and channel gags. The machine is in the shape of a vertical cylinder which traverses the reactor on a gantry. The operation of the machine and the fuel-handling procedures used in conjunction with it are described. Drawings and photographs are included. (D.L.C.)

8284 XENON POISONING DURING TWO SHIFT OPERATION. D. L. Booth (Atomic Power Division, English Electric Co., Ltd.). Nuclear Power 5, 110-13 (1960) Dec.

Xenon concentrations during cyclic operation were calculated by an electronic analog computer. Results obtained were for a wide range of load cycles and are applicable to reactors with peak fluxes up to approximately six times those in current gas-cooled uranium-fueled designs. The method of simulation, effects of step changes in flux, and effects of step cycles are discussed. (M.C.G.)

8285 PROGRESS IN TECHNOLOGY. 1. REACTOR ENGINEERING. R. F. W. Guard (Kennedy and Donkin, London). Nuclear Power 6, No. 57, 74-7(1961) Jan.

A review is presented of current reactor projects and progress all over the world. It is divided into the following topics: gas-cooled reactors (system layouts, both current and proposed, pressure vessels, thermal cycles, and fuel-element problems); advanced gas-cooled reactors (Windscale, Hero, Dragon HTGR, and Peach Bottom HTGR) water-cooled reactors (boiling, pressurized, and heavy water); organic-moderated reactors; liquid-metal-cooled reactors; and fuel cycles (U^{233}, plutonium, thorium, and natural uranium). (D.L.C.)

8286 IRRADIATION TECHNIQUES FOR FISSILE MATERIALS. [PART] II. O. S. Plail (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Nuclear Power 6, No. 57, 82-5(1961) Jan.

The development of irradiation thimbles for use at 200 to 800°C in the Dido and Pluto D_2O-cooled research reactor is discussed. The thimbles are arranged so as to be cooled by liquid H_2O, with a thermal barrier of helium gas between the coolant and the thimbles. Overcooling is provided with auxiliary heating. The rig is designed with a temperature control so that thermal cycling effects can be ignored in the irradiation experiments. In operation so far, no failures have been observed due to the water jackets. (D.L.C.)

8287 THE REACTOR SUPPLY INDUSTRY. Richard A. Tybout. Bureau Business Research Monograph Number 97. Columbus, Ohio, Ohio State University, 1960. 91p.

A study is presented on employment, investment, and competitive relation in the private reactor supply industry The study is based on information obtained by mail survey and gives primary attention to AEC information services and their effect on competition (big vs. small business) in this supply area. A synopsis of the findings and their projection into the future are given. (D.L.C.)

8288 IMPROVEMENTS IN OR RELATING TO CONTROL MEANS FOR EFFECTING CONTROLLED MOVEMENT OF A MEMBER IN AN ENCLOSED SPACE. Jack

ritt (to Rolls-Royce Limited). British Patent 848,075. ept. 14, 1960.

A reactor control rod drive mechanism is designed which ffects rod movement by means of a magnet wrapped around ne rod cylinder and a supply of a pressure fluid, e.g., iquid sodium coolant. In operation, the magnet is moved n the desired direction, up or down, and the pressure fluid s applied automatically to move the control rod in the ame direction. Two configurations of the mechanism and neir details and operation are given. (D.L.C.)

289 IMPROVEMENTS IN AND RELATING TO UCLEAR REACTOR FUEL ELEMENTS. Andrew Thomas owden (to C. A. Parsons & Co. Ltd.). British Patent 52,644. Oct. 26, 1960.

The end closure for reactor fuel elements consisting of ranium clad with an alloy of low strength properties, e.g., agnesium alloys, is designed so that the stresses on the eld from handling operations are reduced. This reduction s brought about by constructing the end closure member ith a projection of reduced cross section on the side away om the fuel element; the container wall is pressed into ntact with the projection to form a shoulder which bears resses from lifting or lowering the fuel element, and the utting edges of the container and end closure member re welded. (D.L.C.)

290 IMPROVEMENTS IN OR RELATING TO ELEC- RIC MOTOR AND PUMP ASSEMBLIES. (to Siemens- chuckertwerke A.G.). British Patent 854,165. Nov. 16, 960.

An electric motor and pump assembly suitable for umping hot liquids under high pressure in reactors is ffered. The casing of the pumping means and the casing f the driving motor together form a pressure-proof hous- ng with inlet and outlet apertures for the liquid and an xternal cooling device. The motor is located below the ump so that contamination of the liquid by abraded parti- les is avoided. (D.L.C.)

291 NUCLEAR REACTORS. (to Sulzer Freres, ociete Anonyme). British Patent 855,391. Nov. 30, 1960.

A reactor fuel element containing fissile rods with em- edded cooling tubes is designed so that assembling the od lengths with consequent tube joining is facilitated. The lement contains three fissile rods with two cooling tubes ach and of a cross section in the form of a figure 8 with cooling tube in each loop of the figure; the three rods are rranged within the element so that the cooling tubes form pentagon with a sixth tube in the center. The cooling ubes are made of zirconium for use with pressurized ater as coolant. (D.L.C.)

292 IMPROVEMENTS IN NUCLEAR REACTORS. nthony James Taylor (to Babcock & Wilcox Ltd.). British atent 856,213. Dec. 14, 1960.

An improved core and pressure vessel supporting means s designed comprising a hollow pressure vessel support olumn united at its upper end with the vessel wall at an perture therein and a core support column extending from ithin the vessel through the aperture into the hollow col- mn. This arrangement enables the columns to flex inde- endently of each other and thus to reduce thermal stresses. D.L.C.)

293 IMPROVEMENTS IN AND RELATING TO GAS IRCULATORY MEANS. John Reginald Bolter and Richard ull Beaton (to C. A. Parsons and Co., Ltd.). British atent 856,722. Dec. 21, 1960.

A gas circulatory means for gas-cooled reactors is de- igned comprising a chamber having outer and inner cas- ings, an axial flow gas circulator located in the inner cas- ing at one end, a gas outlet at the other end of the inner casing, a gas inlet to the annular space between the inner and outer casings, and a gas flow path from the inlet to the end of the chamber where the circulator is located and thence in a reverse direction to the outlet. The circulator rotor has a frusto-conical face which forms a seal with a similarly shaped face on the circulator housing. The advantages of this design are that the circulator can be removed from the casing by breaking only one sealing joint, pressure loss is minimized, and with the use of a stand-still seal the rotating shaft seal can be checked without depressurizing the whole system. Drawings are included illustrating the circulatory means and how it can be used in a reactor with steam generating means. (D.L.C.)

8294 IMPROVEMENTS RELATING TO FUEL ELE- MENT CANS FOR NUCLEAR REACTORS. Dermot Frederick Hughes (to English Electric Co., Ltd.). British Patent 856,740. Dec. 21, 1960.

A reactor fuel element can is designed comprising a can with at least one external helical heat transfer fin and at least two external subdividing fins, the latter extending lengthwise on the can and intersecting the helical fins. A drawing is included illustrating a can for use in a gas-cooled, graphite-moderated reactor. (D.L.C.)

8295 IMPROVEMENTS RELATING TO FUEL ELE- MENTS FOR NUCLEAR REACTORS. Walter Alexander Ward, Christopher Brocklebank Fell, and Charles Herbert Quinton Fifield (to A.E.I.-John Thompson Nuclear Co., Ltd.). British Patent 856,839. Dec. 21, 1960.

A fuel-element assembly, consisting of a finned fuel element mounted in a carrier with vertical struts so that the element weight is supported by the carrier, is redesigned to minimize fuel-element bowing due to high temperatures, which may lead to assembly jamming in the fuel passage. This minimization is accomplished by bands encircling the fuel element at intermediate points and secured to the vertical struts of the carrier. Drawings are included. (D.L.C.)

8296 IMPROVEMENTS IN OR RELATING TO NU- CLEAR REACTORS. William Frank Wood (to United Kingdom Atomic Energy Authority). British Patent 856,922. Dec. 21, 1960.

A reactor is described which uses discrete solid bodies of fissile material distributed in moderator materials, e.g., beryllia marbles containing plutonium, contained in a hanging vessel built of blocks of moderator materials, e.g., beryllia. Cooling gas may be pumped into the core and out through perforations in the reactor floor, although other possible coolant paths are discussed. A reflector mass surrounding the reactor may be built of beryllia marbles. The fuel marbles are of the same type as those described in Patent Specification No. 848,901. Drawings are included. (D.L.C.)

8297 IMPROVEMENTS IN OR RELATING TO FAST BREEDER REACTORS. (to Walther and Cie Aktiengelle- schaft). British Patent 856,946. Dec. 21, 1960.

A liquid-fuel fast-breeder reactor with continuous fuel processing and low activity outside the reactor is designed, comprising a reactor vessel filled with a liquid fissile metal, an alloy, a suspension or salt and a liquid breeder vessel blanketing the reactor vessel. Pipes are installed in both the reactor and breeder vessels for cooling, withdrawing a minor part of the fissile and fertile liquids for continuous processing, and returning the processed liquids to the vessels. One drawing is included. (D.L.C.)

8298 IMPROVEMENTS RELATING TO FLUID COOLED NUCLEAR REACTORS. Geoffrey John Bealey, Roderick Sorlie McKean, and Eric Lee Saunders (to A.E.I.-John Thompson Nuclear Energy Co., Ltd.). British Patent 856,950. Dec. 21, 1960.

A throttle member is designed for setting the flow of a fluid coolant in a reactor core fuel channel at a predetermined level which is independent of the number of fuel elements in the channel. The throttle member comprises a length of ducting located in the lower part of the channel and with a passage of cross-sectional area tapering in the flow direction and a movable flow restriction disk with a spring positioned between the disk and the passage. In operation, excess coolant flow due to fuel-element removal from the channel forces the disk against the spring toward the passage until a new equilibrium with reduced coolant flow is reached. The disk has bypass passages to prevent complete coolant shutoff. This throttle member is particularly applicable to gas-cooled reactors. Drawings are included. (D.L.C.)

8299 ELECTROMAGNETIC DISPLACING MEANS FOR NEUTRON ABSORBING CONTROL RODS. (to Allmänna Svenska Elektriska Aktiebolaget). British Patent 857,059. Dec. 29, 1960.

An electromagnetic device for displacing reactor control rods is designed comprising a tubular stator built up from a plurality of soft iron rings slid on a nonmagnetic tube containing a cylindrical armature which supports a control rod. The iron rings have slots for coils through which current is passed in such a manner that a multipolar d-c field is produced, and the armature is constructed of magnet poles and yokes; the interaction between the multipolar d-c and magnetic fields positions the armature and its control rod in the desired place. Harmonic interference is eliminated by making the pole pitches of the stator and armature slightly different from each other. One drawing is included. (D.L.C.)

8300 IMPROVEMENTS RELATING TO NUCLEAR REACTORS. John George Morland and Roderick Sorlie McKean (to A.E.I.-John Thompson Nuclear Energy Co., Ltd.). British Patent 857,202. Dec. 29, 1960.

A device for regulating the gas flow in a control-rod channel and for absorbing impacts from dropped control rods in gas-cooled reactors is designed comprising (1) a gag member with a vertical bore and gas channels which is fixed at the base of the control-rod channel and (2) a removable impact stool with a head and a stem resting on top of the gag member and inside its bore, respectively, which partially shields the gag gas channels to regulate the flow. The impact stool can be replaced by another stool of different dimensions to vary the amount of flow regulation, and it resists control rod impacts, thereby reducing moderator damage. (D.L.C.)

8301 METHOD FOR POISON OVERRIDE IN NUCLEAR REACTORS. (to Atomic Energy of Canada, Ltd.). British Patent 857,318. Dec. 29, 1960.

An economical method for overriding the Xe^{135} poisoning in thermal reactors resulting from shutdown is described which consists of lowering a standby fissile source into the reactor to furnish the necessary excess reactivity and then withdrawing it from the reactor as soon as it is restarted. The total cost of this method is estimated to be on the order of $\$10^4$/milli-k, much smaller than the capital charge of $\$5 \times 10^5$/milli-k for obtaining the necessary reactivity at the expense of reduced fuel burn-up. Hence this method should help thermal power reactors using natural uranium fuels be more competitive as commercial power sources. The method can also be used as an auxiliary reactor control system. Drawings are presented for one embodiment of the method for a D_2O-moderated reactor, in which means are provided for moving plates containing an aluminum–U^{235} alloy between the reactor and a gas-tight enclosure containing helium. (D.L.C.)

8302 IMPROVEMENTS IN OR RELATING TO SUPPORT MEANS FOR A NUCLEAR REACTOR FUEL ELEMENT. John Brian Byford Mills (to General Electric Co., Ltd.). British Patent 857,422. Dec. 29, 1960.

A fuel element support means is designed comprising a beam which spans a fuel channel to provide a supporting abutment for the end of a fuel element. The beam is adapted to engage in grooves or slots in the channel wall and to receive a spigot on the fuel element. The beam may be made out of sintered alumina based ceramic material, graphite, or metal. Drawings are given which illustrate the use of the beam to support finned and clad uranium rods. (D.L.C.)

8303 IMPROVEMENTS IN OR RELATING TO MEANS FOR SHUTTING DOWN NUCLEAR REACTORS. Everett Long, Frank Geoffrey Greenhalgh, and Laurence Hack (to United Kingdom Atomic Energy Authority). British Patent 857,432. Dec. 29, 1960.

A secondary shut-down system that will operate in the event of pressure-vessel rupture is designed comprising a magazine of boron-steel balls positioned above a tube in the reactor core and held in position by the magnetic field of energized coils. Upon coil deenergization, the balls fall into the tube to operate as a shut-down rod. When it is desired to restore the system to its inoperative state, the tube containing the balls is moved up with a grab and the balls placed in the magazine. Drawings are included. (D.L.C.)

8304 IMPROVEMENTS IN OR RELATING TO NUCLEAR REACTORS. Andre Huet. British Patent 857,675. Jan. 4, 1961.

An arrangement is described for accurately moving fuel (and possibly control) rods apart or together in a reactor, enabling the reactor to be controlled and eliminating the need for control or moderating rods. The fuel rods are arranged in rows with the rods of each row mounted slidably on a support, and a first mechanical device is provided for varying the distances between rods on a support and a second one for the distances between the supports. The mechanical devices may be of three kinds: articulated quadrilaterals, threaded nuts, and telescopic screws. Drawings are given illustrating the applications of all three. (D.L.C.)

8305 IMPROVEMENTS IN AND RELATING TO FUEL ELEMENTS FOR NUCLEAR REACTORS. Andrew Thomso Bowden (to C. A. Parsons and Co., Ltd.). British Patent 858,770. Jan. 18, 1961.

A fuel element in which the fuel is housed in a container is designed so that the tendency of the container to spring away from the fuel and to assume a barrel shape is minimized. In this design, wedge-shaped grooves are formed in the fuel with the narrow part lying in the groove mouth, and the container is forced into the groove by pressure. A locking effect is thus obtained. (D.L.C.)

8306 APPARATUS FOR REGULATING THE COOLING FLUID FLOW IN THE CHANNELS OF A NUCLEAR REACTOR. (to Commissariat a l'Energie Atomique). British Patent 859,069. Jan. 18, 1961.

An apparatus for regulating the coolant flow in reactors is described in which a device with coolant passages of predetermined cross section is mounted in a regulating channel disposed below a reactor channel. The device is constructed with engaging fingers and de-engaging means for mounting and removing from the channel without emptying the channel or stopping the pile entirely (50% stoppage is adequate), so that coolant regulation can be varied easily by exchange of devices of different caliber. A block with storage spaces for devices of this type is provided below the reactor core. (D.L.C.)

8307 IMPROVEMENTS IN OR RELATING TO NUCLEAR REACTORS. John William George Gregory (to United Kingdom Atomic Energy Authority). British Patent 859,172. Jan. 18, 1961.

A recording apparatus for testing reactor coolant gas samples for fission products due to fuel element sheath rupture is designed to function without constant inspection. In this apparatus, the cyclical voltage signals from the precipitator are encoded on perforated tape and the tape fed into a reader circuit which controls a computer and alarm circuit. (D.L.C.)

8308 IMPROVEMENTS IN OR RELATING TO NUCLEAR REACTORS. Raymond John Cox (to United Kingdom Atomic Energy Authority). British Patent 859,209. Jan. 18, 1961.

A method for determining simultaneously the coolant outlet temperature and the integral flux in a reactor coolant channel is described which measures the induced radioactivity in coolant samples. This method is especially applicable to reactors using oxygen-containing coolants, e.g., CO_2, air, H_2O, D_2O, and organic compounds, since the N^{16} activity induced by the reaction $O^{16}(n,p)N^{16}$ is proportional to the integral flux divided by the coolant flow rate and is an indirect measure of the fuel element temperature in the channel. A suitable instrument for measuring the N^{16} activity is a scintillation counter at the channel outlet followed by a discriminator which accepts only the 6-Mev γ rays from N^{16} decay. (D.L.C.)

8309 NUCLEAR REACTORS CONTAINING FUEL ELEMENTS. (to Sulzer Frères, Société Anonyme). British Patent 859,395. Jan. 25, 1961.

Five embodiments are described of a fuel element which contains an outer ring of eight fuel rods and an inner fuel region richer in fissile material than the outer ring. The inner region may consist of a single fuel rod, several fuel rods, or several fuel plates arranged in various ways, and cooling tubes are provided in all the fissile parts. The value of the fuel element design is in that the consumption of rich fissile material is reduced without losing its advantages, e.g., reduction of minimum reactor size for chain reaction and increased fuel burn-up limits. (D.L.C.)

8310 IMPROVEMENTS RELATING TO NUCLEAR REACTORS. John Herbert Coupland (to English Electric Co., Ltd.). British Patent 859,471. Jan. 25, 1961.

A design of a reactor having a lattice network to fuel channels in a moderator structure is described whereby a higher reactor output can be obtained. In this design, the working area of the moderator is divided into two or more concentric zones of different lattice pitch so that more fuel elements per unit area are provided in the inner zone where the neutron flux is highest. (D.L.C.)

8311 IMPROVEMENTS IN OR RELATING TO NUCLEAR REACTORS. Alan Arnold Griffith. British Patent 859,494. Jan. 25, 1961.

A permeable reactor fuel in block form may be fabricated by manufacturing sheets of the metal, corrugating the sheets, stacking them one on top of another, and brazing, welding, or sintering them into a rigid block. The advantages of such a reactor fuel are that an extensive heat transfer surface is provided, that the hottest metal in the block is supported by cooler metal, and that a laminar gas coolant flow can be used. A helium-cooled reactor using this type of reactor fuel is described; in this reactor, with helium introduced at 400°C and discharged at 800°C (metal temperature being 900°C), a heat transfer rate of 0.7 kw per gram metal was attained. (D.L.C.)

8312 NUCLEAR REACTOR CONTROL ROD. (to U. S. Atomic Energy Commission). British Patent 859,548. Jan. 25, 1961.

A thin wide control member is designed comprising a plurality of triangular tubes joined side to side and neutron-absorbing slugs disposed within the tubes. The slugs are confined to the lower ends of the tubes without bonding by tubular retainers and plugs. Space is provided for gases up to a pressure of 40,000 psi and the slugs may be replaced easily. (D.L.C.)

8313 METHOD OF QUICKLY RESTORING NORMAL AIR CONDITIONS IN BUILDINGS CONTAINING ATOMIC REACTORS AFTER A SUDDEN INCREASE IN PRESSURE AND TEMPERATURE. (to Aktiebolaget Svenska Flaktfabriken). British Patent 859,653. Jan. 25, 1961.

A scheme for cooling the air inside a building is outlined which does not require pumps or fans. In this scheme, air is cooled in the upper part of the building space by ammonia, carbonic acid, or other freezing medium led to the heat exchanger by its own pressure. The pressure is regulated so that the vaporization of the freezing medium occurs at a temperature a few degrees above 0°C. The scheme is especially applicable to reactor buildings into which large quantities of cooling water were discharged after pressurized water reactor accidents. (D.L.C.)

8314 IMPROVEMENTS IN OR RELATING TO NUCLEAR REACTOR ARRANGEMENTS. Peter Arnold Lindley (to General Electric Co., Ltd.). British Patent 859,799. Jan. 25, 1961.

A gas-cooled, graphite-moderated reactor design is described which prevents storage of energy in the core by means of self-annealing. This self-annealing is accomplished by bleeding off a portion of the outgoing hot gas coolant before it reaches the heat exchanger and reintroducing it into the reactor by way of the control rod holes and/or Wigner gaps. In this way, the minimum temperature of the core is maintained above that at which self-annealing occurs. (D.L.C.)

8315 IMPROVEMENTS IN OR RELATING TO NUCLEAR FUEL ELEMENTS. Harold Montague Finniston, Leslie Mark Wyatt, and Oliver Sidney Plail (to United Kingdom Atomic Energy Authority). British Patent 859,940. Jan. 25, 1961.

Aluminum-cased uranium bodies for reactor use which do not form swellings at ~300°C due to interface alloying may be fabricated by interposing a film between the aluminum and uranium. Such films must be made of a substance which does not diffuse readily into uranium and aluminum at temperatures up to 800°C, and suitable substances are graphite (dispersion in a volatile solvent) and copper and silver films. Procedures are given for preparing the aluminum can and uranium body for coating with the above substances. (D.L.C.)

8316 IMPROVEMENTS IN OR RELATING TO PROTECTIVE CANS FOR NUCLEAR REACTOR FUEL ELEMENTS. Eric William Vickers Acton (to General Electric Co., Ltd.). British Patent 859,960. Jan. 25, 1961.

A finned tube for reactor fuel elements is designed with two types of helical fins. The first type, heat-exchange fins, is usually integral with the tube and may be produced by extrusion. The other type, nonintegral and of a different helical angle from that of the first type, may be attached to the tube by slotting and fitting over the other fins. (D.L.C.)

8317 NEUTRONIC REACTOR CONTROL ELEMENT. H. W. Newson (to U. S. Atomic Energy Commission). U. S. Patent 2,952,600. Sept. 13, 1960.

A novel composite neutronic reactor control element is offered. The element comprises a multiplicity of sections arranged in end-to-end relationship, each of the sections having a markedly different neutron-reactive characteristic. For example, a three-section control element could contain absorber, moderator, and fuel sections. By moving such an element longitudinally through a reactor core, reactivity is decreased by the absorber, increased slightly by the moderator, or increased substantially by the fuel. Thus, control over a wide reactivity range is provided.

8318 JACKETED FISSIONABLE MEMBER. E. R. Boller and J. W. Robinson (to U. S. Atomic Energy Commission). U. S. Patent 2,952,603. Sept. 13, 1960.

A fuel element design for a nuclear reactor is presented. The fuel element comprises a cylindrical fuel body having a portion of smaller diameter at each end thereof with an annular flange at the extreme ends of these portions of smaller diameter. An end cap fits over the ends of the fuel body and has an internal annular groove adapted to receive the flange. The fuel body and end caps are disposed in a cup-shaped jacket, a closure disc completing the enclosure of the fuel body, and the caps are bonded over their entire periphery to the jacket.

8319 ELECTROMAGNETIC RELEASE MECHANISM. C. Michelson (to U. S. Atomic Energy Commission). U. S. Patent 2,952,802. Sept. 13, 1960.

An electromagnetic release mechanism is offered that may be used, for example, for supporting a safety rod for a nuclear reactor. The release mechanism is designed to have a large excess holding force and a rapid, uniform, and dependable release. The fast release is accomplished by providing the electromagnet with slotted poles separated by an insulating potting resin, and by constructing the poles with a ferro-nickel alloy. The combination of these two features materially reduces the eddy current power density whenever the magnetic field changes during a release operation. In addition to these features, the design of the armature is such as to provide ready entrance of fluid into any void that might tend to form during release of the armature. This also improves the release time for the mechanism. The large holding force for the mechanism is accomplished by providing a small, selected, uniform air gap between the inner pole piece and the armature.

8320 NEUTRONIC REACTOR. H. L. Anderson (to U. S. Atomic Energy Commission). U. S. Patent 2,953,510. Sept. 20, 1960.

A nuclear reactor is described comprising fissionable material dispersed in graphite blocks, helium filling the voids of the blocks and the spaces therebetween, and means other than the helium in thermal conductive contact with the graphite for removing heat.

8321 NEUTRONIC REACTOR. Eugene P. Wigner (to U. S. Atomic Energy Commission). U. S. Patent 2,954,335. Sept. 27, 1960.

A unit assembly is described for a neutronic reactor comprising a tube and plurality of spaced parallel sandwiches in the tube extending lengthwise thereof, each sandwich including a middle plate having a central opening for plutonium and other openings for fertile material at opposite ends of the plate.

8322 WATER BOILER REACTOR. L. D. P. King (to U. S. Atomic Energy Commission). U. S. Patent 2,961,391. Nov. 22, 1960.

As its name implies, this reactor utilizes an aqueous solution of a fissionable element salt, and is also conventional in that it contains a heat exchanger cooling coil immersed in the fuel. Its novelty lies in the utilization of a cylindrical reactor vessel to provide a critical region having a large and constant interface with a supernatant vapor region, and the use of a hollow sleeve coolant member suspended from the cover assembly in coaxial relation with the reactor vessel. Cool water is circulated inside this hollow coolant member, and a gap between its outer wall and the reactor vessel is used to carry off radiolytic gases for recombination in an external catalyst chamber. The central passage of the coolant member defines a reflux condenser passage into which the externally recombined gases are returned and condensed. The large and constant interface between fuel solution and vapor region prevents the formation of large bubbles and minimizes the amount of fuel salt carried off by water vapor, thus making possible higher flux densities, specific powers and power densities.

8323 NEUTRONIC REACTORS. E. P. Wigner (to U. S. Atomic Energy Commission). U. S. Patent 2,961,392. Nov. 22, 1960.

A nuclear reactor is described wherein horizontal rods of thermal-neutron-fissionable material are disposed in a body of heavy water and extend through and are supported by spaced parallel walls of graphite.

8324 NEUTRONIC REACTOR FUEL ELEMENT. M. L. Picklesimer and W. C. Thurber (to U. S. Atomic Energy Commission). U. S. Patent 2,967,141. Jan. 3, 1961.

A chemically nonreactive fuel composition for incorporation in aluminum-clad, plate type fuel elements for neutronic reactors is described. The composition comprises a mixture of aluminum and uranium carbide particles, the uranium carbide particles containing at least 80 wt.% UC_2.

8325 METHOD AND APPARATUS FOR CONTROLLING DIRECT-CYCLE NEUTRONIC REACTORS. G. A. Reed (to U. S. Atomic Energy Commission). U. S. Patent 2,967,809. Jan. 10, 1961.

A control arrangement is offered for a boiling-water reactor. Boric acid is maintained in the water in the reactor and the amount in the reactor is controlled by continuously removing a portion of the water from the reactor, concentrating the boric acid by evaporating the water therefrom, returning a controlled amount of the acid to the reactor, and simultaneously controlling the water level by varying the rate of spent steam return to the reactor.

8326 FUEL ELEMENTS FOR THERMAL-FISSION NUCLEAR REACTORS. O. Flint (to U. S. Atomic Energy Commission). U. S. Patent 2,967,811. Jan. 10, 1961.

Fuel elements for thermal-fission nuclear reactors are described. The fuel element is comprised of a core of alumina, a film of a metal of the class consisting of copper, silver, and nickel on the outer face of the core, and a coating of an oxide of a metal isotope of the class consisting of U^{235}, U^{233}, and Pu^{239} on the metal film.

8327 FUEL ELEMENT FOR NEUTRONIC REACTORS. T. C. Evans and E. G. Beasley (to U. S. Atomic Energy Commission). U. S. Patent 2,968,601. Jan. 17, 1961.

A fuel element for neutronic reactors, particularly the gas-cooled type of reactor, is described. The element comprises a fuel-bearing plate rolled to form a cylinder having a spiral passageway passing from its periphery to its center. In operation a coolant is admitted to the passageway at the periphery of the element, is passed through the spiral passageway, and emerges into a central channel defined by the inner turn of the rolled plate. The advantage of the element is that the fully heated coolant (i.e., coolant emerging into the central channel) is separated and thus insulated from the periphery of the element, which may be in contact with a low-temperature moderator, by the intermediate turns of the spiral fuel element.

8328 NEUTRONIC REACTOR FUEL ELEMENT AND METHOD OF MANUFACTURE. H. M. Finniston and O. S. Plail (to U. S. Atomic Energy Commission). U. S. Patent 2,969,309. Jan. 24, 1961.

A uranium body for use in a nuclear fission reactor is described. It has a homogeneous rod of uranium metal enclosed in an envelope of aluminum, wherein a thin metallic layer of higher melting point than aluminum and of relatively low competitive neutron absorption between the uranium and the aluminum is bonded to the uranium and to the aluminum of the sheath.

8329 NEUTRONIC REACTOR SYSTEM. J. J. Goett (to U. S. Atomic Energy Commission). U. S. Patent 2,969,310. Jan. 24, 1961.

A system is described which includes a neutronic reactor containing a dispersion of fissionable material in a liquid moderator as fuel and a conveyor to which a portion of the dispersion may be passed and wherein the self heat of the slurry evaporates the moderator. Means are provided for condensing the liquid moderator and returning it to the reactor and for conveying the dried fissionable material away from the reactor.

8330 MEANS FOR PRODUCING PLUTONIUM CHAIN REACTIONS. E. P. Wigner and A. M. Weinberg (to U. S. Atomic Energy Commission). U. S. Patent 2,969,311. Jan. 24, 1961.

A neutronic reactor is described with an active portion capable of operating at an energy level of 0.5 to 1000 ev comprising discrete bodies of Pu^{239} disposed in a body of water which contains not more than 5 molecules of water to one atom of plutonium, the total amount of Pu^{239} being sufficient to sustain a chain reaction. (auth)

8331 IMPROVED TYPE [OF] FUEL ELEMENT. H. O. Monson (to U. S. Atomic Energy Commission). U. S. Patent 2,969,312. Jan. 24, 1961.

A radiator-type fuel block assembly is described. It has a hexagonal body of neutron fissionable material having a plurality of longitudinal equal-spaced coolant channels therein aligned in rows parallel to each face of the hexagonal body. Each of these coolant channels is hexagonally shaped with the corners rounded and enlarged and the assembly has a maximum temperature isothermal line around each channel which is approximately straight and equidistant between adjacent channels.

Power Reactors

8332 (AE-34) THEORETICAL CALCULATION OF THE EFFECT ON LATTICE PARAMETERS OF EMPTYING THE COOLANT CHANNELS IN A D_2O-MODERATED AND COOLED NATURAL URANIUM REACTOR. P. Weissglas (Aktiebolaget Atomenergi, Stockholm). May 1960. 20p.

Paper presented at the Symposium on Reactor Physics Calculations, March 21-23, 1960.

A study was made to evaluate theoretically the effect of coolant boiling and subsequent void formation in a pressurized D_2O-moderated and -cooled reactor. The fuel rods were arranged in a cluster geometry and clad in Zircaloy-2. The coolant was separated from the moderator by a Zircaloy-2 shroud. In this geometry the following problems were given special attention: (1) calculation of the effective resonance integral, (2) thermal disadvantage factors, (3) fast fission effects, (4) leakage effects, and (5) changes in epithermal absorption. No account has up to now been taken of the variation of these effects with position in the reactor and burn-up. Some comparisons of the theoretical methods and measurements were attempted. It is concluded that at the present time it is not possible to calculate the void coefficient with any accuracy but it may be possible to give an upper limit from theoretical consideration. (auth)

8333 (AECL-1155) A CANADIAN APPROACH TO NUCLEAR POWER. J. L. Gray (Atomic Energy of Canada Ltd., Chalk River, Ont.). Dec. 1960. 30p.

Address given during Inauguration Ceremonies Canada-India Reactor, Bombay, India, 16th-19th January 1961.

A review of the main Canadian approach to nuclear power and the place it has in the Canadian power program is presented. A neutron economical reactor is best suited for the present conditions. The qualities of heavy water as a moderator were exploited, and a concentrated effort was made to achieve high burn-up of natural uranium fuel. Utilization of natural uranium to the point that the irradiated fuel may be considered as a waste product eliminates many items of capital expenditure and many unsolved technical problems related to the enriched fuel cycle and low burn-up natural uranium cycle. The flexibility associated with the application of heavy water as a moderator is considered important to the program. (W.L.H.)

8334 (CEND-83(Vols. I and II)) ABWR QUARTERLY PROGRESS REPORT, JANUARY 1 TO MARCH 31, 1960. VOLUME I. SL-1 OPERATIONS [AND EVALUATION]. VOLUME II. SL-1 HEALTH PHYSICS AND SAFETY. R. T. Canfield, W. P. Rausch, E. J. Vallario, R. G. Young, and S. K. Henderson (Combustion Engineering, Inc. Nuclear Div., Idaho Falls, Idaho). May 25, 1960. 32p. Contract AT(10-1)-967. (IDO-19013(Vols.I and II)).

The Stationary Low Power Reactor No. 1 is a three Mw boiling water reactor designed to demonstrate the feasibility of a nuclear reactor to supply electrical power and space heat for remote sites. In addition to performance evaluation the facility provides training for military personnel. The reactor was operated for 1159 hr during the quarter for a total core burnup of 20.3%. Power generation was 103.7 Mwd for a total power accumulation of 466.9 Mwd. Eight malfunctions occurred during the quarter for a total unscheduled downtime of 40 hr 44 min. As a result of malfunctions, aluminum keys will be installed on the control rod drives, instrument well covers were removed, and an order has been placed for a station auxiliaries breaker with a higher temperature rating. Data were taken on seven tests during the quarter. Four of these are expected to be completed during the next quarter. All equipment items on order for the SL-1 power extrapolation expansion program are scheduled to be delivered before June 15, 1960. Although condenser dampers and damper controls, process

instrumentation, equipment cabinets, and the radiation monitoring equipment have not yet been ordered, construction will not be delayed. The two tie-ins to the existing reactor piping which were required have been made. The engineering and decontamination buildings are nearing completion and will be ready for occupancy in early May. An SL-1 operational cost analysis for March of electrical power generated, based on military personnel only, indicated a mil rate of 107. (auth)

8335 (CF-53-6-6) NUCLEAR ENERGY FOR ROCKET PROPULSION. R. W. Bussard (Oak Ridge National Lab., Tenn.). July 2, 1953. Dec. Oct. 7, 1960. 94p. Contract W-7405-eng-26.

The results of a rocket vehicle study indicate that nuclear-powered rocket vehicles will be lighter than comparable chemically powered vehicles for vehicle velocities greater than 15,000 ft/sec with payload weights of 1000 to 10,000 lb, or for vehicle velocities greater than 7000 ft/sec with payload weights greater than 10,000 lb. The reactor core design study shows that high reactor core bulk power densities might be achieved without an undue gas pressure drop across the reactor or an excessive temperature drop from the fuel element to the gas. The best core design appears to be one that utilizes thin, parallel, solid graphite plates as the heat-transfer elements. Since the propellant gases are predominantly hydrogen, the use of graphite as the basic structural material will require the development of a hydrogen-resistant coating to be applied to the surfaces of the graphite heat-transfer elements of the reactor core in order to inhibit chemical reactions between the gas and the graphite. The feasibility of the reactor core designs considered thus depends on the efficacy of the protective coatings proposed for the graphite heat-transfer elements. Thus the first step in a program of development of a nuclear rocket should be an experimental investigation of protective coatings for graphite for operation in hydrogen. (auth)

8336 (CF-59-2-82) FUEL CYCLE COSTS IN A GRAPHITE MODERATED U^{235}–Th FUELED FUSED SALT REACTOR. C. E. Guthrie (Oak Ridge National Lab., Tenn.). Feb. 27, 1959. 8p.

A fuel-cycle economic study was made for a 315-Mw(e) graphite-moderated U^{235}–Th-fueled fused-salt reactor. Fuel cycle costs of ~1.3 mills/kwh may be possible for such reactors when reprocessed for U^{233} and U^{235} recovery at the end of a 9-year cycle. Continuous removal of fission products during the reactor cycle does not appear to offer any great economic advantage for the converter reactor considered. (auth)

8337 (CF-61-1-19) WATER TREATMENT IN AQUEOUS HOMOGENEOUS REACTORS, EXPERIENCE IN HRE-2. P. D. Neumann (Oak Ridge National Lab., Tenn.). Jan. 4, 1961. 14p.

A method for water treatment was developed for corrosion protection in the steam-water cycle of Homogeneous Reactor Experiment No. 2. The use of potassium phosphates for pH control, hydrazine for oxygen removal, and limitation of chlorides in the boiler water to less than 1 ppm has resulted in trouble-free operation of the steam system from Dec. 1957 to Dec. 1960. Excessive radiolytic decomposition of hydrazine led to the conclusion that the cost of oxygen removal by hydrazine would prohibit its use in a utility plant powered by homogeneous reactors unless an intermediate heat-exchanger cycle were added to the design. Other solutions to the problem of oxygen generation are suggested for investigation. (auth)

8338 (CF-61-1-50) SOURCES AND AVAILABILITY OF HELIUM. A. P. Fraas (Oak Ridge National Lab., Tenn.). Jan. 19, 1961. 4p.

A review of helium sources, availability, consumption, and future production capacity indicates that the helium consumed in the operation of 100 helium-cooled reactors for 300-Mw(e) power plants over a 20-year period will run no more than a few % of the helium consumed in the U. S. in the next 25 years, and less than 1% of the helium that is to be stored during that period under the helium conservation act of 1960 (Public Law 86-777). (auth)

8339 (CVNA-59) CAROLINAS VIRGINIA NUCLEAR POWER ASSOCIATES, INC., RESEARCH AND DEVELOPMENT PROGRAM QUARTERLY PROGRESS REPORT, APRIL–MAY–JUNE 1960. (Westinghouse Electric Corp. Atomic Power Dept., Pittsburgh). 254p.

Work continued on nuclear design calculations using the NDC code. This code is used (for the IBM-704) to calculate lattice parameters for cells of pressure tube reactors. The cell model is composed of four concentric homogeneous regions, namely, the fuel-coolant region, thermal baffle region, tube region, and moderator region. Various fuel cycling schemes were studied using the CYCLONE code. Two-region and three-region fuel cycling were considered and burn-up, radial hot channel factors, and power distribution were determined. A test unit was designed and fabricated to ascertain the effectiveness of the CVTR thermal baffles. The test facility is flexible. Some tests were run and the results obtained were within 20% of Jakob correlation. More refined calculations of the heat losses in the pressure tube were made. The heat losses were determined to be 27% higher than originally calculated. Testing of the in-pile size Zircaloy-stainless steel Conoseal joint was concluded. The joint performed well under temperature and pressure conditions expected during normal CVTR operation. A change was made to the reference design, specifying Conoseal joints rather than seal-welded joints. Progress on the ultrasonic inspection of pressure tubes was confined to the development of a suitable wedge for producing the desired shear wave angles in zirconium and its alloys. It appears that a lead alloy will be most suitable for this purpose. The CVTR Reference Design II clad thickness of 0.033 in. was established on the basis of minimum properties of Zircaloy-2 in the annealed condition. All material and equipment required for the tests to determine the thermal resistance between the Zircaloy cladding and the UO_2 fuel have been procured. The test apparatus is in the final stages of fabrication. The Zircaloy specimens are completed and thermocouple holes are being drilled into the UO_2 specimens. Fabrication of the in-pile loop for the CVTR Irradiation Program was completed. Work on the interconnecting piping was completed and the in-pile loop was installed in the Westinghouse Test Reactor. The design of the pressure tube header assembly was completed. All the calculated stresses were less than the allowable stresses. New layout drawings of the reactor compartment were completed showing the top-suspended moderator tank, the self-standing side and bottom thermal neutron shields, and other recent modifications. The refueling concept was changed from one wherein fuel assemblies would be moved between U-tubes in the core to one wherein entire U-tubes with fuel would be moved. The refueling machine design was revised to incorporate this change in concept. The system proposed for detection of leakage of heavy water in the steam generator utilizes a continuous on-stream infrared spectrometer plus periodic laboratory counting

of the H^3 activity in the secondary water. The spectrometer will measure leakage rates as low as 0.09 lb/hr and the H^3 monitor as low as 0.001 lb/hr. A study was completed to determine the effect of using direct river water cooling in the component cooling system on the ability to detect heavy water leakage. The heavy water lost before detection was determined as a function of leak rate. A simple mathematical model for the oil-fired superheater was obtained. A detailed over-all control study was initiated based on a constant cold leg program and taking into account the pressurizer and superheater. A set of runs is being made to check the control characteristics of the plant and its inherent stability. A study of the reactivity requirements for an effective scram was completed. It was concluded that an insertion of approximately -3.5% Δk is adequate for an effective scram during a period of time from 0 to 5 sec following the insertion. Inertia and scram requirements in case of a complete loss of flow accident were determined. Assuming inertia is added to only one of the two primary coolant pumps, 2.77×10^6 ft-lb of stored energy is necessary if scram is accomplished in 1.5 sec or 4.15×10^6 ft-lb of stored energy is required if scram requires 2.5 sec. A cadmium-aluminum neutron curtain was designed and drawings were prepared for its fabrication. The purpose of this curtain is to act as an adjustable neutron barrier, simulating various reflector arrangements in the critical experiment. Approximately 85% of the required fuel elements were received and the remainder should be delivered in July 1960. All the control rods were delivered. Charging of heavy water into the critical experiment system was completed. Individual fuel rods were assembled into 19 rod clusters, and loading of the core was started. (auth)

8340 (DL-42) DESIGNING HEAVY WATER REACTORS FOR NEUTRON ECONOMY AND THERMAL EFFICIENCY. W. B. Lewis (Atomic Energy of Canada Ltd. Chalk River, Ont.). Jan. 1961. 17p. (AECL-1163).

For presentation at the Formal Inauguration of C.I.R. Bombay, India, January 16-19, 1961.

An attempt is made to outline design highlights. Design studies suggest that by continuing to pay attention to neutron economy, the heavy-water-moderated reactors will set a low cost on nuclear power. Two advances on CANDU are foreshadowed, the attainment of even higher efficiency by the combined use of an organic liquid and superheated steam as coolants, and the elimination of continuous refueling by the use of separated U^{235} and thorium as fuel. (W.L.H.)

8341 (GA-1259) MARITIME GAS-COOLED REACTOR PROGRAM QUARTERLY PROGRESS REPORT FOR THE PERIOD ENDING MARCH 31, 1960. (General Atomic Div., General Dynamics Corp., San Diego, Calif. and General Dynamics Corp. Electric Boat Div., Groton, Conn.). 154p. Contract AT(04-3)-187. OTS.

Reactor design activities continued with emphasis on fuel elements. Two fuel-element concepts were chosen for development. Both were based on the concept of 19-rod clusters with spiral spacers. One is comprised of $\frac{1}{4}$-in.-diameter rods with pure UO_2 fuel bodies whereas the other uses $\frac{3}{8}$-in.-diameter rods with UO_2-BeO fuel bodies. A program is under way to develop methods for the fabrication of fuel rods. Two points receiving most attention are the method of attaching the spiral spacers and the creep-shrink process for controlled collapse of the cladding on the fuel bodies. Tests are being carried out to determine the internal pressures that will cause bursting of the cladding tubes at various temperatures. A mock-up of a part of a semi-homogeneous graphite plate-type fuel element with nickel-clad fuel rods was tested for approximately 1000 hr at a surface temperature of 1500°F. The initial visual examination showed no signs of damage. Tests are continuing on the heat-transfer characteristics of high-pressure helium in tube bundles. A study of the thermodynamic properties of helium at high pressures was completed. Studies were carried out to determine the particular arrangement that satisfies the requirements of accessibility, compactness, low-pressure loss in the ducting, and acceptable thermal stress. A method was developed for analysis of the dynamics of the MGCR power plant by digital computer. Calculations made to date indicate that the system is inherently stable. A start-up accident brought about by too much rod withdrawal was analyzed. It was found that the excursion could be terminated by insertion of the control rods at normal speeds. Analysis of a loss-of-coolant accident indicates that the fuel elements can lose heat to the moderator by radiation for approximately 1 hr before it is necessary to initiate emergency cooling measures to avoid dangerous temperatures on the fuel cladding. Reactor physics work included completion of a survey of the effect of the independent variables: core size, reflector material, void volume, and fuel enrichment on total power cost. Studies were made of the effect of core structure on power cost. The effects were calculated of four different metallic fuel-element shrouds and one alumina sleeve design. Calculated control-rod requirements indicate a need for control of 49% reactivity to cover the range of conditions from hot to cold and flooded. Flux contours were calculated in three different degrees of detail. By using combinations of these distributions, it is possible to obtain approximate flux at any point in the core. The generation of tritium by n,α reaction in the BeO moderator was calculated. Methods of calculating criticality are being checked against critical experiments at Livermore and the NTS "Hot Box," Materials work is continuing with development of techniques for fabrication of ceramic fuel bodies. Specimens of UO_2-Al_2O_3 bodies were irradiated to 9000 Mwd/t. Investigation is continuing to establish the best means of fabrication of beryllia shapes for the moderator and reflector. Tests are continuing to establish creep-rupture and fatigue strength of structural metals in high-temperature helium. (For preceding period see GA-1195.) (auth)

8342 (HPR-7) THE HALDEN PROJECT EXPERIMENTAL PROGRAMME. H. Ager-Hanssen and V. O. Eriksen (Norway. Institutt for Atomenergi, OEEC Halden Reaktor Prosjekt). Oct. 1960. 53p.

For presentation at the EAES Enlarged Symposium on Heterogeneous Heavy Water Power Reactors, Mallorca, 10th—14th October, 1960.

Activities in a program of study to provide information on scientific aspects of the Halden reactor are summarized. The program includes an experiment using a fuel charge consisting of aluminum-clad natural uranium elements in which a maximum power of 5 Mw at a primary steam pressure of 5 atm is to be attained. In a second experimental program it is planned to use slightly enriched uranium oxide elements canned in Zircaloy; the reactor will be brought up to 20 Mw at a primary steam pressure of 30 atm. The reactor physics program is designed to establish various parameters of importance for operation and for interpretation of dynamic study results. Reactor dynamic studies are planned to examine the plant characteristics under varied operating conditions. The thermodynamic studies are aimed at obtaining information on boiling dynamics, and development of instrumentation for measuring

thermodynamic parameters. Chemical and metallurgical studies are also discussed. (J.R.D.)

8343 (JPL-TR-32-42) GASEOUS FISSION REACTORS FOR SPACECRAFT PROPULSION. Robert V. Meghreblian (California Inst. of Tech., Pasadena. Jet Propulsion Lab.). July 6, 1960. 14p. Contract NASW-6.

The ultimate performance potential of nuclear fission rockets is determined with the aid of an idealized reactor model that postulates a nontemperature-limited (gaseous) region of nuclear fuel-bearing material. A generalized system is obtained by incorporating a radiator heat sink in the model. The resulting conclusions that are drawn thus apply directly to low-acceleration (interplanetary) applications. The characteristics of the postulated nuclear engine are found to include a combined high specific impulse (thousands of seconds) with a relatively high engine thrust-to-weight ratio (10^{-3} to 1). Applications to spacecraft result in substantial reductions in total trip time for missions to the near planets over that possible with electric propulsion systems. (auth)

8344 (KAPL-M-AJA-3) FLOW RATES DURING BLOWDOWN OF PRESSURIZED WATER REACTORS FOLLOWING RUPTURE OF COOLANT INLET PIPING. A. J. Arker and R. A. Kaufman (Knolls Atomic Power Lab., Schenectady, N. Y.). Sept. 8, 1960. 31p. Contract W-31-109-Eng-52.

Flow rates were measured during the blowdown of water from a 518-gal vessel through 1.5-in. orifices of varying lengths. The water at the orifice inlet was subcooled approximately 100°F. The measured rates were compared with two existing correlations for flashing flow and were found to be lower than those predicted by the correlations. The evaluation of the results is presented here. (auth)

8345 (LAMS-2487) QUARTERLY STATUS REPORT ON LAMPRE PROGRAM FOR PERIOD ENDING NOVEMBER 20, 1960. (Los Alamos Scientific Lab., N. Mex.). Dec. 1960. 29p. Contract W-7405-eng-36.

A decision was made to begin fabrication for the initial core loading of LAMPRE-1 with capsules from the tantalum on hand. Fuel for the first loading will be the cast Fe–Pu alloy from LCX III capsules and will contain carbon and stabilizer. Certification and melt-freeze tests are continuing on LAMPRE type capsules. The filling of the reactor sodium system is described. The cover gas system operated satisfactorily during the sodium shakedown phase. Four of the 15 core thermocouples have operated improperly since the sodium system was filled. The capsule charges were operated to remove dummy capsules and insert tantalum capsules containing test coupons. The 2000-kw Sodium Test Facility, including test steam generator, was operated continuously from Aug. 20 to Nov. 20, except for 159 hr of shutdown required for maintenance of auxiliary steam system equipment. Mercury-water flow systems were set up and are being operated to study both lift and jet pumping. A second fuel pumping experiment using Co–Ce–Pu fuel was set up and tried without success. The effects of various additives on the properties of Fe–Pu fuels are being studied. The fabrication of LAMPRE-1 capsules by impact-extruding a rod-slug into a starting cup followed by six ironing stages is described. Materials that were corrosion tested as fabricated capsules include arc-melted and electron-beam-melted high-purity tantalum and Ta–0.1 wt. % W alloy. Corrosion tests are in progress on experimental deep-drawn capsules made from Ta–0.1 wt. % W–0.2 wt. % Y. An x-ray fluorescence spectrographic method was developed for determining hafnium in Ta–Hf and Ta–W–Hf alloys. Work is in progress on the development of a solvent extraction method for the recovery of plutonium residues from various pyrometallurgical processes. (For preceding period see LAMS-2462.) (W.L.H.)

8346 (NAA-SR-3379) PRELIMINARY SAFEGUARDS REPORT BASED ON URANIUM–MOLYBDENUM FUEL FOR THE HALLAM NUCLEAR POWER FACILITY. Theodore L. Gershun, ed. (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). [nd]. 226p. Contract AT-11-1-GEN-8.

The Hallam Power Reactor is described relative to site, buildings, reactor and associated heat-transfer system, instrumentation and control, auxiliary systems, and fuel and component handling facilities. The potential hazards of radioactivity and safeguards for confinement are discussed. Radiation levels and accidental effluent release are considered. Transients with and without protective system action are discussed. (B.O.G.)

8347 (NAA-SR-Memo-5442) LCTL TEST OF HNPF MODERATOR CANS. E. C. Phillips (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). June 29, 1960. 34p.

In a test of Hallam Nuclear Power Facility stainless-steel moderator cans, a cluster of seven of these was heated isothermally to 1010°F in sodium. Subsequently the cans were thermally shocked to produce a maximum temperature difference of 154°F between the centers and edges of the can flats. Test results indicated that sensitization and depassivation of can surfaces is likely to take place during reactor operation. (J.R.D.)

8348 (NAA-SR-Memo-5772) FARSE—A FIRST ORDER APPROXIMATION OF REACTOR SHIELDS FOR SNAP SYSTEMS, PART I–NON-SCATTERED DOSE. K. L. Rooney and M. A. Boling (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Oct. 11, 1960. 34p.

The FARSE code is designed to investigate the effect of complex shield geometries on over-all shield weight and payload dose profile for SNAP reactor systems. The program computes dose deposit at each target mesh from each source mesh using an attenuation model based on mean free paths traversed along a straight line trajectory. FARSE requires 51 pieces of input information per case and machine time is of the order of three to six minutes. Options in the code enable one to specify the shield and obtain the dose; or conversely, specify dose rates and tolerance across the payload and determine a shield system which will satisfy these conditions. (W.L.H.)

8349 (NYO-9072) PEBBLE BED REACTOR PROGRAM. COOLBALL: A MACHINE CODE FOR THERMAL ANALYSIS OF PEBBLE BED REACTOR CORES. (Sanderson and Porter, New York). Oct. 1960. 57p. Contract AT(30-1)-2207.

COOLBALL is an IBM 650 machine program designed to calculate local gas and ball temperatures, gas flow, and pressure loss as induced by nonuniform power generation and voidage within an axial flow pebble-bed reactor core. This code was used extensively to study the thermal characteristics of pebble-bed reactor cores in support of a broad program for the development of the PBR concept. (auth)

8350 (ORNL-3032) A DEVICE TO SIMULATE THE SERVICE THERMAL CONDITIONS IN EGCR-TYPE FUEL ELEMENTS. W. R. Martin and J. R. Weir (Oak Ridge National Lab., Tenn.). Contract W-7405-eng-26.

An investigation into the dimensional behavior of the

Experimental Gas-cooled Reactor (EGCR) fuel capsule at elevated temperatures required the design and development of a device to simulate the service thermal conditions for the EGCR. This apparatus was designed. Central UO_2 temperatures of 4000°F can be attained with radial thermal gradients of several hundred °F. Heating and cooling rates of 1000°F/min can be obtained. This equipment can be used for various other types of experiments. With few modifications, thermal expansion, thermal conductivity, thermal cycling, and short-time tensile tests can be carried out in environments of controlled composition and pressure. A description of the apparatus, its capabilities, and examples of tests completed using it are given. (auth)

8351 (ORNL-3046) MARITIME REACTOR PROJECT ANNUAL PROGRESS REPORT FOR PERIOD ENDING NOVEMBER 30, 1960. (Oak Ridge National Lab., Tenn.). Jan. 17, 1961. 62p. Contract W-7405-eng-26.

Construction of the N. S. Savannah is nearing completion. Experimental measurements were made of the pseudo-diffusion coefficient, D′, of the N. S. Savannah core 1 fuel pellets. This property is used for characterizing the fission-gas retention properties of UO_2 fuel pellets. Charpy V-notch impact specimens made from type A212, grade B steel scrap from the N. S. Savannah reactor vessel's upper closure head were irradiated in the Maritime pressurized-water loop in the Oak Ridge Research Reactor. Waste disposal studies, aimed at the development of improved techniques for sea disposal of radioactive wastes from nuclear merchant ships, were terminated. Construction of the Maritime pressurized-water loop in the Oak Ridge Research Reactor was completed. Substitution of Zircaloy for stainless-steel fuel containers was found to have pronounced effects on core physics; these effects were exhibited principally by a decrease in the enrichment required for a given multiplication and by an appreciable increase in control-rod worth. Work on advanced fuel materials consisted principally of metallurgical investigations of alternate fabrication methods for encapsulating UO_2 in stainless steel. (W.L.H.)

8352 (SRO-40) HEAVY WATER POWER REACTOR PROGRAM MONTHLY PROGRESS REPORT, DECEMBER 1960. (Savannah River Operations Office, AEC). 18p.

A summation of development activities on various heavy-water power reactor components under AEC contract is presented. The design, construction-time estimates, and results of tests on components of the Savannah River Components Test Reactor (HWCTR) are presented. The status of programs on beryllium development, cladding and fuel-element fabrication, and the Parr Shoals Power Reactor is discussed. (For preceding period see SRO-39.) (W.L.H.)

8353 (WAPD-237) ECONOMIC POTENTIAL OF THE SEED-BLANKET REACTOR. F. Schwoerer (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). Dec. 1960. 97p. Contract AT-11-1-GEN-14. OTS.

The economic potential of the seed-blanket reactor concept was evaluated and compared with that of slightly enriched reactors. The study included consideration of various refinements and alternates in core design—such as, multiple seeds, spikes, blankets of slight enrichment, changes in cladding material, and fuel rotation schemes. The effects of possible changes in basic cost parameters, such as the AEC pricing of enriched uranium, fuel use charges, reprocessing costs, and fabrication costs were considered. Fuel-cycle costs were derived for cases in which core lifetimes are limited by (a) reactivity effects and (b) metallurgical considerations. When improvements that can be made in the two core types are taken into account, the seed-blanket core appears to have an economic advantage over the slightly enriched core; but the difference in power costs, which is on the order of ½ mill per kilowatt hour, is within the range of uncertainty that applies to estimation of costs for such long-lived reactors. This range of uncertainty can be narrowed only by building and operating reactors of both types and actually determining the practical reactivity lifetimes of these cores and the associated metallurgical limitations. Aside from the economics, the seed-blanket concept has certain inherent advantages over slightly enriched reactors. These include (a) lower inventory of enriched uranium, (b) production of considerable power in natural uranium, (c) use of standard fuel materials (natural and highly enriched)—thus avoiding the necessity of producing and stocking fuel of a variety of enrichments, (d) less mechanical control, (e) somewhat simpler refueling and probably less down-time for refueling, (f) a better load-following characteristic, and (g) better adaptability to the use of plutonium fuel. (auth)

8354 (WAPD-MRP-89) PRESSURIZED WATER REACTOR (PWR) PROJECT TECHNICAL PROGRESS REPORT FOR THE PERIOD OCTOBER 24, 1960 TO DECEMBER 23, 1960. (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). 133p. Contract AT-11-1-GEN-14.

The manufacture of Core 2 fuel elements was started. Approximately 400,000 blanket fuel wafers were compacted, and 200,000 were sintered. Approximately 75,000 seed fuel wafers were compacted and Zircaloy-4 ingots for blanket and seed receptacle plates were rolled to final thickness. Analyses and tests, which confirm the adequacy of the mechanical design, were completed. FEDAL sampling rake testing was started and a mechanical alignment study of the core was completed considering worst cases of clearances, manufacturing tolerances, and deflections and their effect on the reactivity control system. Designs of the support-flange instrumentation from the support tubes in the bottom support to the lateral support were approved. Air-flow studies in a 0.4 scale model of PWR-2 were completed. No gross changes in core-flow distribution or areas of flow instability were detected. Studies are being conducted to investigate methods of increasing the allowable core power level at 9,100 to 10,000 EFPH by control-rod programming schemes. The program for irradiation of fuel and poison materials for the seed of Core 2 produced measurements of swelling after irradiations approximating the maximum expected during the lifetime of the seed. Fuel platelets containing ZrO_2 + 34 wt.% UO_2 and ZrO_2 + 46 wt.% UO_2 were irradiated to 31.2×10^{20} and 32.3×10^{20} fissions/cc, respectively; and they show maximum increases in thickness of 15.7 and 25.7%. One compartment of a sample containing ZrO_2 + 46 wt.% UO_2, irradiated to 24.2×10^{20} fissions/cc failed; the unfailed five remaining compartments showed a maximum increase in thickness of 22%. One sample of 30 wt.% B_4C + SiC which contained an intentionally defected compartment showed abnormal swelling of this compartment after about 30% burnup of the B^{10} atoms (9.5 mills max). An adjacent nondefected compartment showed no significant dimensional change. A test of 48 previously irradiated ceramic fuel specimens and 5 burnable poison specimens, gave an indication of high specimen temperatures after one day of operation. Examination after shutdown revealed an unidentified deposit on the samples. It was determined that B_4C–SiC mixtures free from localized large B_4C–SiC agglomerates could be prepared by properly blending B_4C powder of 2-μ (average) particle diameter with

SiC powder of 5-μ (average) particle diameter. Corrosion testing of hot-pressed B_4C–SiC compacts in 680°F water showed that the only significant factor affecting corrosion resistance is the amount of open porosity. Reduction of the stress-relieving temperature from 1150 to 700°F of Zircaloy cladding components, which had been cold rolled to a 25% reduction prior to isostatic pressure bonding, effectively eliminated the grain-growth problem. Pressure fatigue results on compartments in isostatic-pressure-bonded plates β-quenched from 1850°F continue to indicate properties that compare favorably with those previously determined on as-bonded plates. The effectiveness of pyrolytic carbon vs. sprayed graphite coatings on fuel wafers for minimizing uranium penetration into the cladding was further confirmed. After 3500 EFPH of operation of PWR Core 1 Seed 2 at Shippingport, the observed critical position of the controlling group of rods during full power operation is substantially below the previously predicted value; however it is believed that the lifetime prediction of 6500 EFPH is not grossly in error. Comparisons of the measured and calculated critical conditions, excess reactivities, and one-rod-withdrawn shutdown margins at various temperatures in cores containing the PWR Core 2 UO_2 mock-up fuel were completed. Measurements and calculations were made at 470°F of the U^{235} activation distributions in the seed and blanket regions of a 5×4-cluster UO_2 slab assembly in PWR Core 2 geometry. Examination of an Inconel holding spring, removed from the blanket at the end of the first seed lifetime, revealed essentially no change in properties as a result of reactor operation. Core 1 power capability from 4000 EFPH of operation with Seed 2 to the end of Seed 2 lifetime was determined. Values range from 115% at 4000 EFPH to 106% for the end of Seed 2 life. Seed power sharing calculated from Shippingport test data shows excellent agreement with prediction. A test, performed to provide information on the effects on core performance of operating with boilers with different heat-transfer areas, indicated a relatively small effect on core power symmetry. Installation of vortex breakers and the seal welds between the downcomers and the steam-drum wrapper corrected the lack of flow in the first downcomer in the hot end of the 1A and 1D steam generators. (For preceding period see WAPD-MRP 88). (auth)

8355 (WCAP-4050) CAROLINAS VIRGINIA NUCLEAR POWER ASSOCIATES, INC. MONTHLY PROGRESS REPORT, CVTR PROJECT. (Westinghouse Electric Corp. Atomic Power Dept., Pittsburgh). Dec. 1960. 30p. Contract AT(30-1)-2289. OTS.

Work was continued on the evaluation of heavy-water moderating characteristics. Nuclear data were generated and results from critical experiments were evaluated for the purpose of fixing the prototype moderator tank diameter. Fabrication of ~80% of the CVTR Phase II hardware was completed. Calibration of the orifice and venturi meters for the hydrodynamic stability program was completed. Two sets of preliminary results were obtained from the Cs^{137} fission-product analysis of UO_2 samples from the first three rabbit capsules irradiated in WTR. The in-pile dynamic irradiation experiment loop has been in operation for three months for a total of 35 equivalent full-power days. Experimental brazing of specially shaped Zircaloy-2 fin material was carried out. Critical experiments to obtain differential and integrated control rod worths were begun. Drop measurements were made using sixteen control rods to determine the effective shutdown by this number of rods. The effect of the length and flow-rate parameters was studied, as well as the number of wire-wrapped rods necessary to achieve satisfactory mixing. (For preceding period see WCAP-4048.) (W.L.H.)

8356 ROCKET PROPULSION WITH NUCLEAR POWER. E. L. Resler Jr. and N. Rott (Cornell Univ., Ithaca, N. Y.). ARS (Am. Rocket Soc.) J. 30, 1099-1101 (1960) Nov.

The nuclear reheat scheme for rocket propulsion using hydrogen propellant is briefly described, and then a scheme using a closed-cycle regenerative gas turbine working between the reactor as a heat source and the liquid hydrogen as a heat sink is treated in detail. The turbine, an AK unit, is filled with high-pressure helium. The maximum gain obtainable from this scheme and the effects of finite regenerator size on its thermodynamic properties are calculated, and the regenerator size needed to accomplish the required heat transfer is then estimated. The advantages of this scheme are discussed. (D.L.C.)

8357 ON PRIMARY CYCLE GAS POLLUTION WITH CORROSION PRODUCTS. J. Beran. Jaderná energie 11, 361-4(1960). (In Czech)

Problems of primary cycle corrosion in nuclear reactors which are important for nuclear power station operation are considered. Under certain simplifying assumptions, the time dependence of corrosion products concentration in cooling medium of gas cooled reactors is derived. (auth)

8358 NUCLEAR SHIP PROPULSION. AN IAEA SYMPOSIUM. R. Anscomb (United Kingdom Atomic Energy Authority, Risley, Lancs, Eng.). Nuclear Power 6, No. 57, 86-8(1961) Jan.

The papers presented by various countries at the IAEA Symposium on Nuclear Ship Propulsion are summarized. The international activities in this field, design rules, shields, fueling, waste disposal, and port assessments are discussed in particular. The Rock 'n' Roll experimental facility proposed by Norway is illustrated. (D.L.C.)

8359 JASON OPERATING EXPERIENCE. [PART] II. J. C. Bolton and M. G. Tennet (Hawker Siddeley Nuclear Power Co. Ltd., [London]). Nuclear Power 6, No. 57, 89-91(1961) Jan.

The temperature and void coefficients of reactivity and the effects of fuel-element removal and neutron-absorber introduction on the reactivity were measured in the Jason reactor. The neutron-flux distributions were determined for all three directions: axial, azimuthal, and radial. The procedures used in these measurements are described, and the data are presented in graphical form together with a table of the reactor specifications. (D.L.C.)

8360 PROGRESS REPORT ON THE DRESDEN NUCLEAR POWER PLANT. J. J. Poer (Commonwealth Edison Co., Chicago) and V. D. Nixon. p.95-105 of "Proceedings of the American Power Conference."

The Dresden power plant is briefly described, and its component, nuclear, and heat transfer characteristics are tabulated. Its training program, construction, and pre-operational and operational testing are also described. (D.L.C.)

8361 ECONOMIC ATOMIC POWER—WHEN? W. L. Budge and B. L. Lloyd (Westinghouse Electric Corp., Pittsburgh, Penna.). p.106-117 of "Proceedings of the American Power Conference."

The principal economic differences between nuclear and conventional power plants are pointed out, and a scheme for the integration of nuclear plants into a modern power system is outlined. The nuclear plants, operating on lower fuel cost than that of conventional fossil fuels, take up the

base load while conventional plants supply the intermediate and peaking loads of the system. A dynamic model of this scheme is also considered. It is emphasized that future fuel costs for nuclear and conventional plants and annual carrying charge rates must be evaluated carefully if a valid economic comparison is to be made. (D.L.C.)

8362 SUPERHEATED STEAM FROM NUCLEAR ENERGY. C. R. Braun and C. B. Graham (Allis-Chalmers Mfg. Co., Milwaukee, Wis.). p.118-29 of "Proceedings of the American Power Conference."

The present status of nuclear superheat research is briefly described, and the Pathfinder plant is discussed in detail: its equipment arrangement, recirculation pump and steam separators, reactor core, fuel elements for the boiler region and superheater, and power distributions in the core. A 330-Mwe target plant based on the Pathfinder data is described, and the possibility of constructing small- and medium-sized plants (20 to 150 Mwe) to test designs is discussed. Some of the problems needed to be solved before nuclear power plants are made competitive are discussed, and it is emphasized that more and more plants should be designed, built, and operated continuously. (D.L.C.)

8363 GAS-SUSPENSION COOLANTS FOR POWER REACTORS. G. K. Rhode, D. M. Roberts, D. C. Schluderberg, and E. E. Walsh (Babcock & Wilcox Co., Lynchburg, Va.). p.130-7 of "Proceedings of the American Power Conference."

Data on gas-suspension coolants are reported which confirm the advantages of these coolants over gas coolants for reactor use (reduced equipment costs, increased heat transfer, and reduced pumping power required for equal heat transport). Graphite particles of size 1 to 5μ were suspended in N_2, He, CO_2, Ne, or Ar and cycled in a high-temperature heat transfer test loop in which the temperature extremes were 200 and 1000°F. After 11 hr operation, the arithmetic mean particle size was reduced by a factor of ~2, but the reduction decreases with time and does not affect the heat transfer and pressure drop characteristics of the coolant. The test loop was operated successfully for >300 hr; no materials incompatibility, wear, corrosion, or erosion were detected in the system. Heat transfer coefficients up to 3000 Btu/hr/sq ft/°F/ft were obtained, and the use of turbulence promoters to improve heat transfer is discussed. Other advantages of gas-suspension coolants are given. (D.L.C.)

8364 LIQUID FLUIDIZED BED REACTOR PROGRAM. Martin R. Scheve (Martin Co., Baltimore). p.138-46 of "Proceedings of the American Power Conference."

In this treatment of the Liquid Fluidized Bed Reactor Program, an investigation of the feasibility of a reactor fueled with pellets fluidized by liquid, some of the potential advantages of this reactor type, and the problems being studied under this program are discussed. The abrasion studies and critical experiments now being undertaken are described, and a reference reactor design is presented together with a table of its expected characteristics. (D.L.C.)

8365 PROCESS HEAT REACTORS FOR INDUSTRY. R. W. Ritzmann (U. S. Atomic Energy Commission, Washington, D. C.). p.147-68 of "Proceedings of the American Power Conference."

A review is given of the possible market for process heat furnished by reactors. Several market surveys show that: (1) twice as much fossil fuel is used to produce process heat as to produce electric power, (2) the amount of fossil fuel which might be conserved by using reactors is half that used by the utility industry, (3) the fossil fuel used for process heat is consumed in small blocks, 85% being less than Mwh, (4) reactors for process heat above 1400°F cannot be integrated easily with processes using such heat, (5) there is no present market for process heat above 2200°F, and (6) only a small portion of manufacturing costs of the process industry is attributable to fuel, leading to plant location nearer to the source of raw materials than to the source of fuels and consequently to higher fuel costs. The AEC heat reactor program is next reviewed. For low-temperature process heat, a cost analysis was performed for four available reactor types for steam production, using a size of 40 Mwh and a maximum steam pressure of 175 psig, and the factors limiting the validity of the analysis are discussed in detail. The Experimental Low Temperature Process Heat Reactor, currently being built, is intended to prove the feasibility of such steam production. For high-temperature process heat, the situation is much less clear, but several programs and one reactor experiment (Turret) are being carried on in this field. Some of the problems facing AEC on the question of a demonstration of process heat reactor feasibility are discussed, and it is stated that the best demonstration would be a reactor built and operated by an industry without government assistance. (D.L.C.)

8366 NUCLEAR HEATED BOILERS. Robert C. Barnett and B. Norval McDonald (Babcock & Wilcox Co., Barberton, Ohio). p.169-79 of "Proceedings of the American Power Conference."

The requirements for design of safe nuclear-heated boilers are discussed under the headings: hazards, codes and specifications, and structural and thermodynamical properties (circulation, steam-water separation, high stress). The following boiler types are treated in detail and their design data presented: vertical and horizontal drum boilers for pressurized water reactors, indirect and direct cycle boilers for boiling water reactors; single-tube, once-through and double-tube, natural circulation boilers for liquid sodium-cooled reactors; and moderate temperature, recirculated and high-temperature, once-through boilers for helium-cooled reactors. (D.L.C.)

8367 NUCLEAR SPACE POWER—SNAP II. F. D. Anderson, D. J. Cockeram, H. M. Dieckamp, and J. R. Wetch (Atomics International, Canoga Park, California). p.347-72 of "Ballistic Missile and Space Technology. Vol. II." New York, Academic Press, 1960.

The SNAP II program objectives and status are outlined and the concepts involved are discussed at length. The vehicle design considerations for application of SNAP II to satellite and space probe missions are treated. Some of the safety precautions which will be used in assembling and testing the reactor are given. The possible hazards associated with rocket explosion and re-entry in the atmosphere were studied and found to be not insurmountable. In re-entry, the rocket may either be burnt up which results only in a low Sr^{90} level compared with that from bomb testing or be placed in orbit long enough for radioactive decay. (D.L.C.)

8368 A ONE-MEGAWATT NUCLEAR ELECTRICAL POWER PLANT FOR SPACE APPLICATIONS. D. P. Ross, E. Ray, E. G. Rapp, and J. E. Taylor (Thompson Ramo Wooldridge Inc., Cleveland, Ohio). p.373-82 of "Ballistic Missile and Space Technology. Vol. II." New York, Academic Press, 1960.

The nuclear potassium vapor power system presented offers attractive weight-to-power ratios and is based on design features permitting development within the next several years. Component design philosophy is such that in the event of a failure in a section of the power plant, a major

portion of the power will remain deliverable. The four rotating machinery packages and the independent condenser-radiators make this possible. Considering the availability of future chemical boosters, the early development of a 1 Mw power conversion system would be of much value to the exploration and utilization of space by man. (auth)

8369 NUCLEAR ROCKET ENGINE CONTROL PROBLEMS IN AN UPPER STAGE INTERPLANETARY VEHICLE. B. P. Helgeson (Thiokol Chemical Corp., Denville, N.J.). Preprint 60-9 of "6th National Annual Meeting 18-21 January 1960." New York, American Astronautical Society, 1960. 18p.

A nuclear engine system of the solid fuel heat exchanger type is described for propulsion of a rocket with sizeable payload from a 300-nautical-mile earth orbit to a 300-nautical-mile Mars orbit. Problems of ground check-out, boost, duty cycle, and shut down are discussed. The generalized thrust duty cycle is characterized by rapidly applied values of impulse in the initial and terminal phases with intermediate navigational requirements for low power operation. The inherent flexibility of operation of the nuclear engine is shown to be attractive for this mission. The need for a simple controls system which does not detract from the characteristic high performance of the nuclear engine is emphasized. (auth)

8370 REACTOR HEAT REMOVAL LIMITATIONS OF NUCLEAR ROCKETS. George Yasui (Lockheed Aircraft Corp., Sunnyvale, Calif.). Preprint No. 1211-60 of "ARS Semi-Annual Meeting, Ambassador Hotel, Los Angeles, Calif., May 9-12, 1960." 34p. (1960).

Certain details of the steady-state heat transfer analysis of nuclear rocket engine design were examined to see what the limitations might be. If the sole restriction on heat removal is a limiting wall temperature, the most efficient means was pointed out to be the constant wall temperature case. But if in addition to the wall temperature there exists some limiting heat flux beyond which fuel element rupture may be expected, then a combined approach is better in which uniform heat generation at the permissible level is followed by a downstream section operating at a constant limiting wall temperature. It is further noted that thrust may be increased by operating at a lower temperature. This study indicated that reduced-power operation may range an order of magnitude for the same gas temperature, provided that the design point was chosen to be at least an order of magnitude above the transition Reynolds Number and due regard was paid to the initial Mach Number. Based on data and the elastic theory of thermal stress, an estimate of the power density to be expected for the graphite element is given. The approximate equations given are useful in predicting quantitatively effects of varying parameters. Limitations on the heat removal rate from nuclear rocket engines were defined, but the indicated values are noted to be only as reliable as the presently available knowledge of the behavior of materials under the extreme conditions to be expected. (auth)

8371 POWER REACTOR TECHNOLOGY. Technical Progress Review, Vol. 3, No. 4. W. H. Zinn (General Nuclear Engineering Corp., Dunedin, Fla.). Sept. 1960. 108p. $0.55(GPO) (Domestic), $0.70(GPO) (Foreign).

Section one is devoted to the waste problem. It includes magnitude and time scales, ultimate disposal of high-level wastes, utilization of wastes, sea disposal, and low-level wastes. Reactor physics is the subject of the second section and discussions are included on recent critical and exponential experiments and fission-product poisoning. The third section, devoted to heat transfer, discusses gas suspension coolants, geometrical considerations, water heat transfer and fluid flow, hot spots and hot-channel factors, and parallel-channel flow. The fourth section presents briefly some of the papers presented at the conference on transfer functions and reactor stability. The effect of radiation on ductile-brittle transition in steel is the subject of the fifth section. The sixth section discusses fuel elements for the Experimental Gas-cooled Reactor and materials for high-temperature gas-cooled reactors. The last three sections are devoted to organic-moderated reactors, nuclear superheat, and the New Production Reactor. (W.L.H.)

8372 IMPROVEMENTS IN OR RELATING TO MODERATOR AND REFLECTOR STRUCTURES FOR NUCLEAR REACTORS. William Rodwell (to United Kingdom Atomic Energy Authority). British Patent 855,358. Nov. 30, 1960.

A reactor moderator and reflector structure restraint member is designed so that sudden and transient horizontal forces as on a ship will not upset the reactor. A modification of the invention disclosed in Patent Serial No. 782,922, the member imposes restraint on the structure by means of a series of elastic bands around the structure, the bands being axially keyed to a restraint cylinder surrounding the structure so that radial growth and differential expansion of the structure are accommodated but no tilting due to horizontal forces occurs. Drawings are included for a graphite moderator and reflector structure. (D.L.C.)

8373 IMPROVEMENTS IN POWER PLANTS. (to Babcock and Wilcox Ltd.). British Patent 856,632. Dec. 21, 1960.

A power plant utilizing steam produced by a reactor is designed in which combustion gases provide a source of superheat and drive a gas turbine to circulate the reactor coolant. In this way, it is possible to ensure coolant circulation even in the absence of power generation in the reactor and to control the superheat and reheat temperatures even at very low steam generation rates. A diagrammatic drawing is included. (D.L.C.)

8374 IMPROVEMENTS IN OR RELATING TO NUCLEAR REACTORS. Andre Huet. British Patent 857,676. Jan. 4, 1961.

A mechanical system for moving the fuel rods and possibly the control rods within a reactor, as described in British Patent 857,675, may be actuated in such a way that the heat emission obeys a predetermined law, e.g., a variable periodic law. In this way, by means of rapid temperature peaks followed by falls in heat emission, it is possible to achieve higher temperatures in reactors without danger. (D.L.C.)

8375 POWER BREEDER REACTOR. (to United States Atomic Energy Commission). British Patent 857,959. Jan. 4, 1961.

A power breeder reactor is designed so that reactivity changes due to operating power and temperature changes and mass volume changes of the core due to temperature differentials are minimized. It comprises a core section of vertical multifaced subassemblies surrounded by a blanket section. Means are provided for preventing lateral movement of the subassemblies near their lower ends, so that volume changes are minimized. (D.L.C.)

8376 COMPOSITE NUCLEAR FUEL ELEMENT AND METHOD OF MANUFACTURE. (to United States Atomic Energy Commission). British Patent 858,061. Jan. 4, 1961.

A process for forming reactor fuel elements is outlined in which an oxide powder of a fissionable material (usually

UO_2) is agglomerated with a resinous binder and a lubricant to form free-flowing granules which then are subjected to cold-pressing and sintering treatments to give compacts suitable for sealing in cans for reactor use. In a period between the pressing and sintering treatments, the compacts are heated to 500 to 900°C in a CO_2 flow to remove the binder and lubricant. In this way UO_2 compacts of 92% theoretical density can be manufactured. The die for the pressing treatment is illustrated. (D.L.C.)

8377 IMPROVEMENTS RELATING TO NUCLEAR REACTORS. William George Edgar Wood (to AEI-John Thompson Nuclear Energy Co. Ltd.). British Patent 858,247. Jan. 11, 1961.

A reactor core for gas-cooled graphite-moderated reactors is designed comprising graphite blocks arranged in vertical stacks with two-slab layers interposed in the stacks and provided with keys to locate the blocks. The minimum Wigner-growth direction of the blocks is arranged to be vertical, whereas the corresponding directions of the two slabs in each layer are horizontal and at right angles to each other. This core design effects compensation for Wigner growth along with sealing against the cooling gas. (D.L.C.)

8378 POWER BREEDER REACTOR. H. O. Monson (to U. S. Atomic Energy Commission). U. S. Patent 2,961,393. Nov. 22, 1960.

An arrangement is offered for preventing or minimizing the contraction due to temperature rise, of a reactor core comprising vertical fuel rods in sodium. Temperature rise of the fuel rods would normally make them move closer together by inward bowing, with a resultant undesired increase in reactivity. According to the present invention, assemblies of the fuel rods are laterally restrained at the lower ends of their lower blanket sections and just above the middle of the fuel sections proper of the rods, and thus the fuel sections move apart, rather than together, with increase in temperature.

8379 REACTOR-FLASH BOILER-FLYWHEEL POWER PLANT. E. Loeb (to U. S. Atomic Energy Commission). U. S. Patent 2,968,602. Jan. 17, 1961.

A power generator in the form of a flywheel with four reactors positioned about its rim is described. The reactors are so positioned that steam, produced in the reactor, exists tangentially to the flywheel, giving it a rotation. The reactors are incompletely moderated without water. The water enters the flywheel at its axis, under sufficient pressure to force it through the reactors, where it is converted to steam. The fuel consists of parallel twisted ribbons assembled to approximate a cylinder.

8380 NUCLEAR REACTOR. J. J. Grebe (to U. S. Atomic Energy Commission). U. S. Patent 2,969,313. Jan. 24, 1961.

A core structure for neutronic reactors adapted for the propulsion of aircraft and rockets is offered. The core is designed for cooling by gaseous media, and comprises a plurality of hollow tapered tubular segments of a porous moderating material impregnated with fissionable fuel nested about a common axis. Alternate ends of the segments are joined. In operation a coolant gas passes through the porous structure and is heated.

Production Reactors

8381 PROCESS AND PLANT FOR THE THERMAL BREEDING OF PLUTONIUM. Kurt Diebner. British Patent 856,054. Dec. 14, 1960.

A thermal breeder reactor system for breeding plutonium is designed comprising two or more reactor stages, one supercritical central stage and one or more subcritical blanket stages surrounding the central stage and separated from the central stage by a gas-filled space so that the tendency of the neutrons escaping from the central stage to reflect back is reduced. In this way, plutonium production exceeds U^{235} consumption. Means are provided for equalizing the pressures in this system. Drawings are presented illustrating the relation between the conversion factor, the multiplication factor, and the moderator-volume ratio and the system. (D.L.C.)

8382 NUCLEAR CONVERSION APPARATUS. G. T. Seaborg (to U. S. Atomic Energy Commission). U. S. Patent 2,952,601. Sept. 13, 1960.

A nuclear conversion apparatus is described which comprises a body of neutron moderator, tubes extending therethrough, uranium in the tubes, a fluid-circulating system associated with the tubes, a thorium-containing fluid coolant in the system and tubes, and means for withdrawing the fluid from the system and replacing it in the system whereby thorium conversion products may be recovered.

Research Reactors

8383 (ANL-6281) SHIELD DESIGN METHODS FOR ARGONAUT-TYPE REACTORS. John Fagan (Argonne National Lab., Ill.). Mar. 1960. 38p. Contract W-31-109-eng-38.

The methods used in calculating the shielding for Argonaut type reactors are described. The shield designs for the Argonaut-1 Reactor and the Argonaut Reactor were investigated. The methods used appeared to be satisfactory within the anticipated limits of accuracy. (auth)

8384 (CF-59-10-38) ESTIMATES OF THE RATE OF INTERNAL HEAT GENERATION IN SEVERAL RESEARCH REACTOR FACILITIES. P. H. Newell (Oak Ridge National Lab., Tenn.). Oct. 1, 1959. 26p.

Estimates of local heat-source distributions were made in several of the research reactor facilities. The temperature difference across a hollow, stainless-steel cylinder was measured; these data were reduced by use of Fourier's heat-conduction equation. The investigation rendered approximate "γ-heat" values which were applied to the design of the gas-cooled, capsule, irradiation experiments. (auth)

8385 (CF-61-1-6) ORR STARTUP ACCIDENT AND COOLING FLOW COASTDOWN ANALOG ANALYSIS. R. S. Stone and A. L. Colomb (Oak Ridge National Lab., Tenn.). Jan. 4, 1961. 17p.

Start-up accident and pump run-down on the ORR were simulated on the Reactor Controls Analog Facility. At full flow the 150% level scram (45 Mw) easily terminates the start-up accident before the metal temperature gets above 180°F. For very low flows typical of criticality runs, temperature coefficients turn the excursion before it reaches 150% of full power; and temperatures climb to boiling, a potentially hazardous condition. This same behavior can occur at full flow if the power is increased to the point where the level scram must be set above 50 Mw. For a pump failure and run-down, it was found that a scram at 80% of flow holds the average metal temperature to 165°C, making this a relatively innocuous accident. This analysis ignored fission product after-heating, which must be considered a separate problem in the long term case at zero flow. (auth)

8386 (CF-61-1-42) REVISED VERSION OF HFIR CRITICAL EXPERIMENT-2 (HFCE-2). P. R. Kasten and

R. D. Cheverton (Oak Ridge National Lab., Tenn.). Jan. 16, 1961. 6p.

A listing and description is given of the experiments associated with the HFIR Critical Experiment-2. The primary experiments concern the reactivity of the bare core, reactivity worth of "gray" control plates, core-power distribution, reactivity worth of "black" control plates, temperature coefficients of reactivity, and the island void coefficient of reactivity. The secondary experiments concern the reactivity of the fuel, and the reactivity worth of a "partial" gray plate. (auth)

8387 (IDO-16667) THE ADVANCED TEST REACTOR–ATR FINAL CONCEPTUAL DESIGN. D. R. deBoisblanc, et al. (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). Nov. 1, 1960. 228p. Contract AT(10-1)-205.

The results of a study are presented which provided additional experimental-loop irradiation space for the AEC-DRD testing program. It was a premise that the experiments allocated to this reactor were those which could not be accommodated in the MTR, ETR, or in existing commercial test reactors. To accomplish the design objectives called for a reactor producing perturbed neutron fluxes exceeding 10^{15} thermal n/cm^2-sec and 1.5×10^{15} epithermal n/cm^2-sec. To accommodate the experimental samples, the reactor fuel core is four feet long in the direction of experimental loops. This is twice the length of the MTR core and a third longer than the ETR core. The vertical arrangement of reactor and experiments permits the use of loops penetrating the top cap of the reactor vessel running straight and vertically through the reactor core. The design offers a high degree of accessibility of the exterior portions of the experiments and offers very convenient handling and discharge of experiments. Since the loops are to be integrated into the reactor design and the in-pile portions installed before reactor start-up, it is felt that many of the problems encountered in MTR and ETR experience will cease to exist. Installation of the loops prior to start-up will have an added advantage in that the flux variations experienced in experiments in ETR every time a new loop is installed will be absent. The Advanced Test Reactor has a core configuration that provides essentially nine flux-trap regions in a geometry that is almost optimum for cylindrical experiments. The geometry is similar to that of a four-leaf clover with one flux trap in each leaf, one at the intersection of the leaves, and one between each pair of leaves. The nominal power level is 250 Mw. The study was carried out in enough detail to permit the establishment of the design parameters and to develop the power requirement which, conservatively rated, will definitely reach the flux specifications. A critical mockup of an arrangement similar to ATR was loaded into the Engineering Test Reactor Critical Facility. (auth)

8388 (NSF-60-39) THE ROLE OF NUCLEAR REACTORS IN UNIVERSITY RESEARCH PROGRAMS. (National Science Foundation, Washington, D. C.). July 1960. 82p.

Results of a study to determine the extent to which research reactors are being used at educational institutions in the United States and Canada are presented. Operational problems associated with these reactors are examined and their effects on technical progress are discussed. Design specifications and experimental facilities are discussed for reactors located at the following institutions: Buffalo University, Cornell University, Georgia Tech., McMaster University, MIT, Michigan University, N. C. State College, Pennsylvania State University, Texas A & M, Virginia University, and Washington State College. An operating budget for a typical pool type reactor is included. (J.R.D.)

8389 (UCRL-6117(Rev.)) RESEARCH PROGRAM AT THE LIVERMORE POOL-TYPE REACTOR. Albert J. Kirschbaum and Walter John (California. Univ., Livermore. Lawrence Radiation Lab.). Nov. 1960. 16p. Contract W-7405-eng-48.

A program of basic research is being conducted at the Lawrence Radiation Laboratory utilizing the Livermore Pool Type Reactor (LPTR). The LPTR is a 1-Mw reactor with provisions for further increases in power. Experimental facilities include six beam tubes, two thermal columns, one through-tube, and several source irradiation facilities. The principal physics experiments being conducted include the investigation of crystal structure by neutron diffraction, liquid-mirror experiments, and crystal diffraction of γ rays. A neutron crystal spectrometer was constructed. With this instrument significant new information was obtained concerning the atomic magnetic structure of antiferromagnetic iron sulfide. The liquid-mirror experiment involves the measurement of the coherent scattering amplitude of hydrogen by reflecting thermal neutrons from various hydrocarbons. The reflected intensity is measured as a function of the hydrogen-to-carbon ratio. For precision energy measurements of γ rays following neutron capture, a bent-quartz-crystal spectrometer is being used in the Cauchois geometry. The binding energy of the deuteron is being measured by diffraction of the n-p capture γ ray. The capture γ rays of vanadium were studied with a NaI sum-coincidence spectrometer. A decay scheme was proposed for V^{51} and V^{52}. A study of the photodisintegration of beryllium near threshold was made using radioisotopes as γ-ray sources. LPTR experiments in the field of nuclear chemistry were mainly concerned with the fission process. In a biological investigation, minute amounts of iodine are determined by exposing specimens to a thermal neutron flux and detecting the radioactive iodine. (auth)

8390 RESEARCH AT WINFRITH. J. Spencer Burkett, ed. Nuclear Power 5, 97-101(1960) Dec.

Construction and research progress at the Atomic Energy Establishment, Winfrith Heath, is surveyed. Eight subcritical assemblies, some transferred from Harwell and others recently constructed, are described. Designs of the zero-energy reactors developed for studies of neutron behavior in graphite systems are discussed. A 10-kw graphite-moderated reactor built as a neutron source for subcritical assemblies is described. Progress on the DRAGON project is also reported. Improvements in control, instrumentation, and computer applications are reviewed. (M.C.G.)

8391 JASON OPERATING EXPERIENCE—1. B. W. Emmerson (Hawker Siddeley Nuclear Power Co., Ltd.). Nuclear Power 5, 102-5(1960) Dec.

The approach to critical and some of the subsequent experiments on the Jason reactor are discussed. The annular core, shielding, instrumentation, and fuel control are described. Acceptance tests performed to check control-rod worth, and void and temperature coefficient are outlined and the results given. (M.C.G.)

WASTE DISPOSAL AND PROCESSING

8392 (CF-59-12-46) PROBLEM STATEMENT—TREATMENT OF DECLAD WASTES FOR DISPOSAL. J. T. Roberts and W. E. Tomlin (Oak Ridge National Lab., Tenn.). Dec. 15, 1959. 5p.

A proposal is given for decladding wastes to be converted

o dry solid "packages" suitable for ultimate storage in a ry environment. Low temperature solidification of Sulfex nd Zirflex decladding wastes by addition of lime, plaster f paris, portland cement, and drying agents, seems feas- ble. A similar treatment of Darex decladding wastes robably should be preceded by chloride removal and itrate destruction. Calcination may be a preferable alter- ative for Darex wastes. (auth)

8393 (HW-63654(Rev.)) OFF-PROJECT EXPOSURE FROM HANFORD REACTOR EFFLUENT. R. F. Foster nd R. L. Junkins (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Feb. 1, 1960. 41p. Contract AT(45-1)-1350. OTS.

A review is presented of reactor effluent discharge to he Columbia River, including calculated and measured adioactivity downstream in relation to limits. The review ontains (1) a description of the quantities of radionuclides n the river, (2) calculated exposures from drinking Co- umbia River water, (3) measured exposures directly from he river, (4) estimated exposure from the consumption of oods, (5) a description of the distribution of Columbia River water in the ocean, (6) observations on the radio- uclide content of marine organisms, and (7) recommenda- ions for additional studies. (auth)

8394 (HW-66276) THE REMOVAL OF CESIUM AND STRONTIUM FROM CONDENSATE WASTES WITH CLI- NOPTILOLITE. B. W. Mercer, Jr. (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). July 29, 1960. 18p. Contract AT(45-1)-1350.

Effective removal of Cs^+ and Sr^{2+} from simulated and actual waste solutions was achieved by adsorption on beds of clinoptilolite. Removal of Cs^+ and Sr^{2+} to C/C_0 values of 10^{-2} to 10^{-4} was attained at flow rates of 0.5 to 6.3 gal/ft^2/min. Small amounts of suspended solids or organic material were found in the actual wastes. The suspended matter contains radioisotopes which are not removed by ion exchange on clinoptilolite. The organic material tends to foul the clinoptilolite—particularly at low pH. Cesium capacities of 105 meq and 19 meq/100 g of clinoptilolite were measured for 0.1 M Cs^+ and 0.001 M Cs^+, respectively, in 1 M Na^+ solutions. The volume put through a clinoptilolite column to 50% breakthrough was constant for Cs^+ concentrations below 0.001 M in 1 M Na^+. A 50-g column of clinoptilolite decontaminated trace Cs^+ from 50,000 column volumes of tap water containing 24 ppm total Ca^{2+} and Mg^{2+}. The C/C_0 values were 0.0002 at 2.7 gal/ft^2/min and 0.01 at 6.3 gal/ft^2/min. Clinoptilolite cesium capacity for decontaminating this tap water was more than 30 times the capacity of a commercial ion exchange resin. (auth)

8395 (HW-67201) REVIEW OF SOIL CHEMISTRY RESEARCH AT HANFORD. D. W. Bensen (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Aug. 10, 1960. 38p. Contract AT(45-1)-1350.

A review of the factors currently known to affect the ability of soil to concentrate radionuclides from solution is presented. Soil adsorption of Cs, Sr, Pu, Zr, Ru, and the rare-earth series isotopes from water and from simulated and actual waste in the laboratory and under field conditions is discussed. Ion exchange, precipitation, and, in some cases, mineral replacement reactions are responsible for radionuclide uptake by soil. The completeness with which an ion is taken up by ion exchange on the soil is dependent upon the concentration of the radionuclide and upon the concentration of accompanying ions. The concentration of the radionuclide and of accompanying cation species is of minor importance in precipitation and in mineral replacement reactions. Cesium is taken up by an ion exchange reaction. In some cases a portion of the cesium is "fixed" in the soil. Strontium is also largely taken up by ion exchange. In calcareous soil strontium can be removed from alkaline solutions by a mineral replacement reaction with calcite ($CaCO_3$). Above pH 2 plutonium and zirconium are largely taken up by precipitation on the soil. The rare-earth nuclides and yttrium are similarly precipitated at pH above 6. Below the pH necessary for complete precipitation, soil uptake of these nuclides presumably occurs by a combination of ion exchange and precipitation. The uptake of trivalent ruthenium is similar to that of the rare earths. Soil uptake of plutonium, zirconium, rare earths, and ruthenium is adversely affected by anions which form complex anionic species with the nuclides. Strontium is usually taken up from alkaline wastes more completely than cesium. However, from an acid waste, cesium uptake is better than strontium. The general order of radionuclide uptake from waste is: Pu > rare earths > Sr > Cs $\gg$ Ru. (auth)

8396 (TID-11412) RETENTION OF FISSION PRODUCTS IN ALUMINO–SILICATE SYSTEMS. Final Report [for] September 1, 1958 through August 31, 1959. (Southwestern Louisiana Inst., Lafayette). 24p. For [Oak Ridge National Lab.]. Subcontract 1339.

Procedures were investigated for fixing radioactive waste in ferro- or alumino-silicate systems by fusion. Procedures for the preparation of the ferro- and alumino-silicate system are described. The synthetic waste solutions used were of the Purex type to which Cs^{137} and Sr^{85} were added. The waste material was mixed with the silicate and fused between 850 and 1050°C. Leaching tests were performed on the fused waste mixture with water and brine. Under the conditions used, a method was devised for the retention of cesium and strontium, within the limits of detection. (W.L.H.)

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